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PERKIN ELMER

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LC-75/85/AUTOCONTROL

SERVICE MANUAL

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PERKIN ELMER

NORWALK, CONNECTICUT U.S.A.

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CAUTION

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This instrument contains high voltage electrical components and other components that may repesent a life threatening danger to those servicing it. We do not advise that our customers attempt to perform any service function themselves unless such functions are set forth in the operator's manual, which is supplied to all customers free of charge. We do not consider any service functions or procedures which are not set out in the operator's manual to be part of the ordinary use and operation of the instrument.

Furthermore, this service manual may be updated from time to time. The Perkin-Elmer Corporation does not undertake any responsibility to supply the purchaser of this manual with such updates, and no subscription service is available. It is the customer's responsibility to request such updates from us, at cost, from time to time.

INTRODUCTION

This manual covers the LC-75, LC-85 and LC Autocontrol. Each instrument is described under a separate cover. The section description of each manual, as described below, is compatabile for each instrument.

Section 1 is a description of the basic instrument.

Section 2 describes the equipment and facilities required for installing the instrument. Section 2 also covers checkout procedures.

Section 3 covers the theory of operation including technical descriptions.

Section 4 covers maintenance and troubleshooting.

Section 5 is a compilation of schematics required to support circuit descriptions and assist in troubleshooting.

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1 GENERAL INFORMATION

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1 GENERAL INFORMATION

1.1 GENERAL

1.1A The LC-75 Detector

The Perkin-Elmer Model LC-75 Spectrophotometric Detector is a single beam, variable wavelength detector, designed for use in a liquid chromatography system. The detector houses a variable wavelength spectrophotometer, a high-pressure flow-through sample cell, and the electronics required to manually control the unit.

The detector permits absorbance detection in the ultraviolet-visible range (190 nm to 600 nm). The spectrophotometer is insensitive to flow noise and to changes in the refractive index of solvents.

The microcell assembly has a cell volume of 8 microliters and can withstand pressures of 14 Mega Pascals (2000 psig). This capability is required when back pressure is applied deliberately to prevent the formation of gas bubbles during gradient elution (see Section 2F).

The Model LC-75 Detector can be used with any laboratory recorder requiring a 10 mV input voltage. A recorder with an input range of 0 to 10 mV (fullscale) is required (Perkin-Elmer Recorder Model 056 is recommended.)

2 INSTALLATION

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2 INSTALLATION

2.1 INTRODUCTION

This section describes the unpacking instructions, setup procedures and checkout procedures.

2.2 UNPACKING INSTRUCTIONS

2.2A LC-75 Detector

1. Before operating the LC-75 Detector, lift the cover and remove the following:

   a) Sponge rubber securing the sheet metal baffle.

   b) Sytrofoam wedges from behind the six metal clips that hold the purge cover to the optical bench.

   c) The tape from behind the counter window on the cover.

   d) The two Tywraps and cardboard tube from the D_2 lamp bracket.

2. Install the D_2 lamp per installation instructions.

2.3 PREPARATION

2.3A General Requirements

Prepare a sturdy bench location in a clean environment with relatively stable temperature and humidity. The detector will operate within the specifications when the ambient temperature ranges from 19 to 30 degrees Celsius. Ambient relative humidity is considered to be from 20 to 80% with no condensation.

2.3B Electrical Requirements

The components of the liquid chromatography system must share a common ground provided by a third wire in the electrical system. Do not tamper with the third prong on the line cord plug. The electrical supply must be capable of providing 100 VA at the nominal voltage and frequency of the instrument in use. Supplies should be clean and free of transient voltages. All electrical supplies must be within ±10% voltage tolerance of the nominal voltage of the particular instrument configuration and must remain within ±10% voltage tolerance. Instruments should not be attached to circuits associated with equipment of a heavy-duty nature (e.g., large motors) or large or frequent loads (e.g., photo-copying systems).

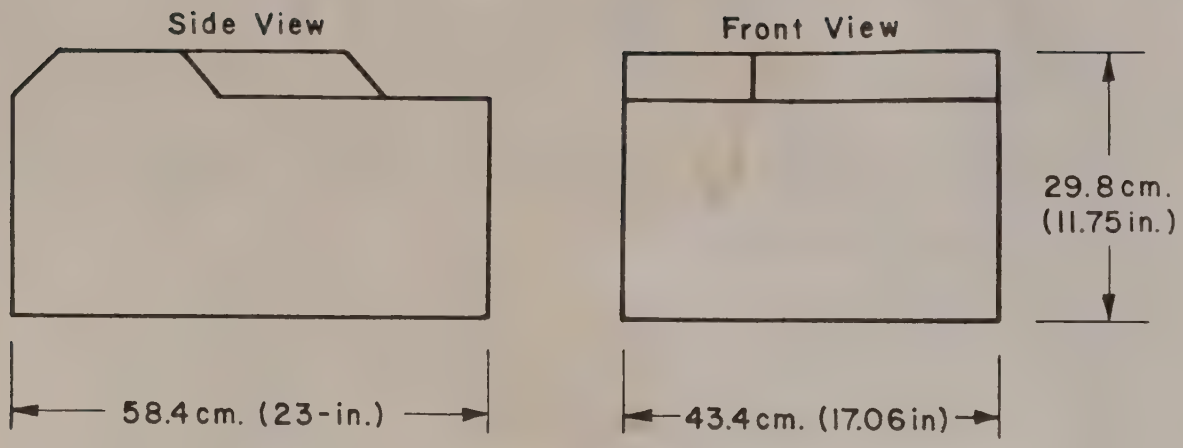


Figure 2-1 - Dimensions of the LC-75

2.3C Gas Requirements

The detector optical paths are enclosed and purgeable with dry nitrogen to remove UV absorbing vapors. Nitrogen used for this purpose must be purge, clean, dust-free, oxygen-free and preferably boiled-off from liquid nitrogen. Pre-purified tank nitrogen is acceptable. Use 1/4-in. fluorocarbon tubing (e.g. Teflon) or equivalent for the nitrogen purge line. DO NOT USE RUBBER OR OTHER TYPES OF PLASTIC TUBING. (See Section 2.3E.)

2.3D Electrical Interconnection

Important: Make certain that the LC-75 Detector, LC Autocontrol and Recorder(s) POWER switches are all OFF and that the AC line cords are removed from the respective AC outlets.

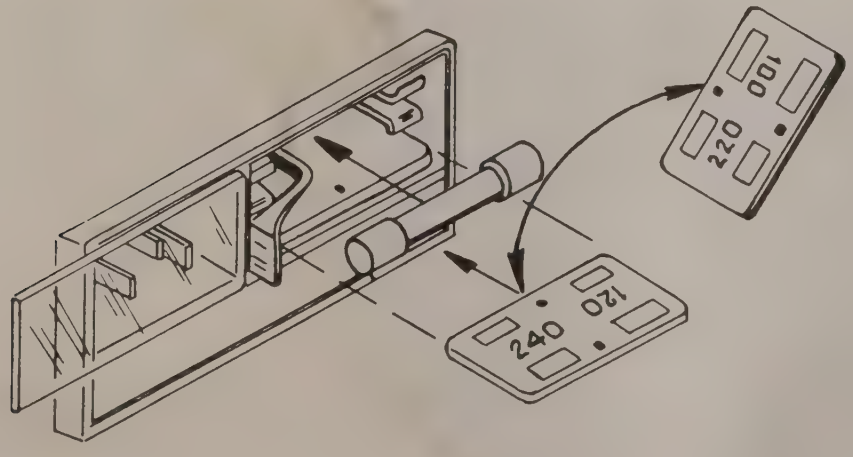


Figure 2-2 - Voltage Selection

1. Power Connection

First, refer to Figure 2-2 and make certain that the small printed circuit board located behind the line fuse (left side panel) is inserted to correspond to the line voltage available. To select the proper operating voltage range setting, remove the AC line cord from the instrument. Slide the clear plastic cover over the fuse all the way to the left. Rotate the FUSE PULL to the left and remove the fuse. Pull out the printed circuit board located below the fuse and orient the printed circuit board so that the desired voltage is legible in accordance with the following:

AC Voltage Range	Legible P.C.B. Setting	Fuse
90-100V	100	1.5A
105-129V	120	1.5A
180-220V	220	.8A
217-258V	240	.8A

Push the printed circuit board back into the slot and rotate the FUSE PULL back into the normal position and make certain that the proper fuse is inserted. Use either a 1.5A (P-E Part No. 0998-1624) or a 0.8A (P-E Part No. 0998-1762) fuse depending on the line voltage. Note that both fuses are provided in the Spares Kit. Use only the proper Slo-Blo fuse.

With the cover down and secured in place and the POWER switch OFF, connect the line cord to a properly-grounded AC outlet.

> Important: All components of the system, e.g., LC-75, the recorder, the solvent delivery module, etc., must share a common ground in the electrical supply system.

2.3E Tubing Connections

1. General

Perkin-Elmer liquid chromatography systems utilize 1/8-in. tubing and fittings upstream of the pump(s) and 1/16-in. tubing and fittings after the pump(s). SSI type fittings are used on the Model LC-75. All of the 1/16-in. tubing is #316 stainless steel or equivalent. When you assemble any of the tubing required in your system, scribe the tubing squarely with a traingular or blade file. Then use two smooth-jaw pliers to separate the pieces of tubing. (See Figure 2-3.) Gently turn the pliers in opposing directions to separate the tubing, gently bending the tube as required. The tubing ends must be free of burrs and snags. Use Figure 2-4 as a guide when you orient the nut and its associated ferrule(s) or collar. Note that the tubing must project past the collar or ferrule. Flush new tubing to clean.

When you make the connection, insert the tubing and collar into the fitting seat. Press and hold the tubing to the seat bottom. Turn the nut into the fitting, carefully tightening the nut with a wrench. Never over-tighten the fitting. Fingertighten the nut and then use a wrench to tighten it no more than 90 degrees past fingertight when the fitting is new (45 degrees past fingertight when the fitting is being reconnected).

Turn on the system and bring the system to its normal operating pressure after making any plumbing modifications. If leaks occur, tighten the fittings an additional 10 degrees. If the leaks persist, disassemble the affected fitting(s) and inspect the fitting(s). The threads should be in good condition and the collar or ferrule(s) should be uniformly deformed. The collar or ferrule(s) should grasp the tubing firmly. If the hardware appears to be in good condition, remake the connection, and tighten to the required level. If the leak still persists, replace the hardware and repeat the procedure until leak-free operation is achieved.

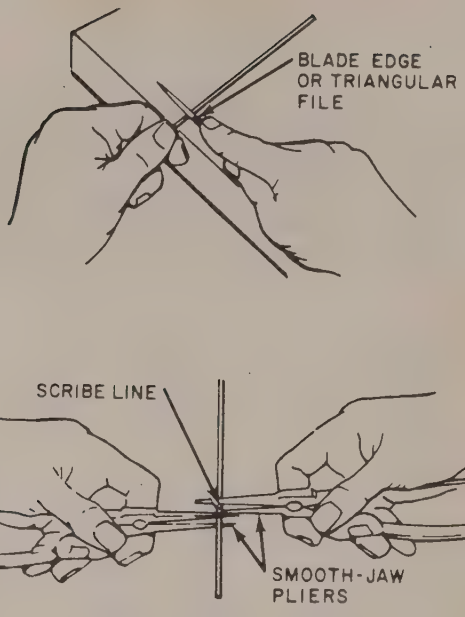


Figure 2-3 - Cutting Stainless Steel Tubing

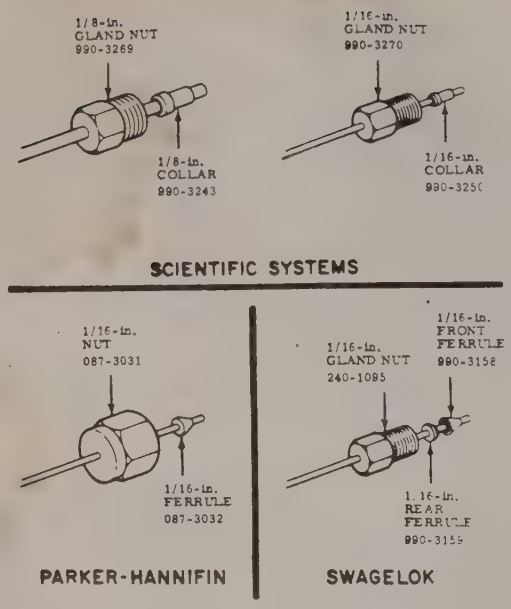


Figure 2-4 - Orientation of Hardware

2. Detector Solvent Lines

One length of unassembled stainless steel tubing and one length of Teflon tubing are provided in the Spares Kit shipped with the LC-75. The stainless steel tubing bears the part number 0087-3036 and is 0.015-in. I.D. tubing while the Teflon tubing (part number 0087-3140) is 17 ga. Only the stainless steel tubing may be used to connect the column outlet to the detector inlet line and the detector outlet to another detector. A union of the zero-dead-volume-type should be used to make the connection.

Generally use the two-meter lengths of 1/16-in. stainless steel tubing provided in the Spares Kit, to connect the detector inlet to the column outlet, if additional length is required. Tubing length from the column oulet to the detector flow cell inlet should be kept to a practical minimum. Cut the tubing to the proper length. Make certain that the tubing is square and free of burrs. Use the Parker-Hannafin nut (0087-3031) and ferrule (0087-3032) at the column connection. Use the SSI hardware at the detector INlet. In a similar fashion, use the remaining length at the detector OUTput. You may use this as a drain (provide a waste container), or you may connect the output line to another detector. Hardware to make connection to another detector is not included with the LC-75. Tighten all the connections no more than 90 degrees past fingertight.

One length of stainless steel tubing and one length of Teflon tubing are provided in the Spares Kit shipped with the LC-75. 17 gauge Teflon tubing (0087-3140) is provided for purging the optics chamber with nitrogen.

A back-pressure regulator is provided and is installed on the cell outlet line (at the user's discretion) to increase the pressure in the flow cell to approximately 50 psi. This aids in reducing the formation of gas bubbles in the cell, decreases detector noise, and improves performance. See Paragraph 4.6D.

2.4 OPERATING INSTRUCTIONS

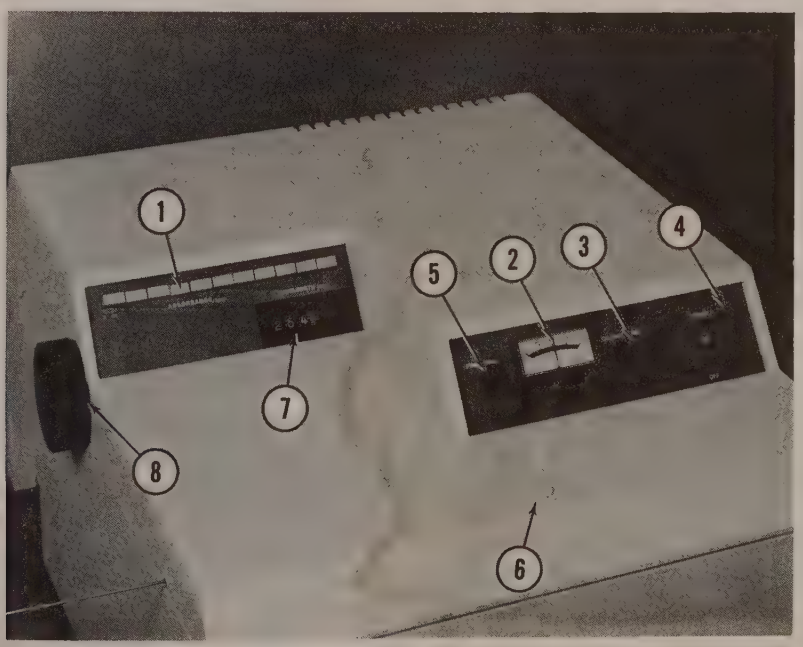
See the end of this section for a summary of these instructions.

2.4A Controls and Indicators

Item numbers correspond to item numbers in Figure 2-5.

1. ABSORBANCE$_{1cm}$ Range Selector - Eleven-position, push-button binary attentuator adjusts the detector signal to the recorder with the most sensitive setting 0.01 Absorbance$_{1cm}$. One of the attenuator settings must be depressed for the detector to operate.

2. Energy Meter - This zero center meter measures the total lamp energy when the COARSE ZERO is fully counterclockwise. Full scale reading is equal in absorbance units to approximately 5A$_{1cm}$ units.



1 ABSORBANCE$_{1cm}$ Range Selector
2 Energy Meter
3 COARSE ZERO
4 POWER Pilot Light
5 FINE ZERO
6 Cap
7 WAVELENGTH Control Knob
8 Wavelength Control Knob

Figure 2-5 - LC-75 Control and Indicators

3. COARSE ZERO Adjustment Control - Turning this control sets the amplifier to approximately zero. Use this knob to maintain the energy meter in the "green" zone.

4. POWER - Placing the associated switch in the ON (up) position provides power to the LC-75. The POWER pilot light (above the ON-OFF switch) illuminates to verify that the power is on.

5. FINE ZERO Adjustment Control - Turning this control fine sets the recorder baseline and data output.

6. Cap - The screw under this cap secures the detector cover and must be in place for normal operation.

7. WAVELENGTH (nm) Indicator - This wheel indicator provides a three digit and first decimal place readout of the wavelength setting, graduated in 0.2 nm increments readable to 0.1 nm.

8. Wavelength Control Knob - Turning this knob sets the detector wavelength.

Important:

1) Do not force the control knob below the 000.0 nm setting or above the 900.0 nm setting.
2) For repeatability, always approach the desired wavelength from the low side.

2.4B OPERATING SUMMARY

1) Connect the INlet line to the column outlet. If unions are used, make certain that they are of the zero-dead-volume-type.

2) Connect the detector signal outputs to the recorder and/or data system. (See Section 2 of the Operator's Manual.)

3) Turn ON the LC-75 POWER. Allow 30 minutes minimum warm-up time. (Allow approximately 2 hours for maximum sensitivity setting.)

4) Select the LC pumping system flow rate and detector compatible solvent composition. Begin pumping. Make certain that all plumbing connections are leak-free.

5) Allow the flow rate to stabilize. (Observe the pumping system pressure.)

6) Use the detector WAVELENGTH dial to select a wavelength appropriate for the analysis. Make certain that the wavelength chosen is above the UV cutoff for the solvent(s) in use. (If the sample absorbance wavelength is unknown, use 250 nm initially as many compounds absorb at this wavelength.

7) Select the $ABSORBANCE_{1cm}$ setting. (The $ABSORBANCE_{1cm}$ is used to keep the peaks-on-scale. A setting of 0.16 is typical.)

8) Observe the baseline until stable. Adjust the signal to 0 to 10% of the recorder scale with the FINEZ ERO control.

9) Inject the sample.

   a) If the peaks go off-scale, select a higher number $ABSORBANCE_{1cm}$ setting to make the peaks smaller. (If a data acquisition device (e.g. P-E Model Sigma Console) is in use, peaks may be allowed to go off-scale.)

   b) If the peaks are too small, use a lower number $ABSORBANCE_{1cm}$ setting.

3 THEORY OF OPERATION

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3 THEORY OF OPERATION

3.1 INTRODUCTION

This section covers the theory of operation and circuit description for the LC-75. Although the components of LC-75 and LC-85 are common in most respects, there are some differences; those differences are covered in the LC-85 Section of this manual.

3.2 LC-75 DETECTOR

The LC-75 Detector is a single beam UV detector which uses an electronic reference. A block diagram is shown in Figure 3-1.

A UV lamp, excited by the UV lamp power supply, is aligned to transmit maximum UV energy into the monochromator. A single wavelength of the UV spectrum (in the monochromator) is selected by the use of a grating and optically transmitted into the flow cell. When a sample is present in the flow cell, the sample absorbs an amount of the UV energy that is passing through it. The energy that is not absorbed is transmitted to the photo-tube. The flow cell is aligned so that maximum UV light is transmitted to the photo-tube.

It is important to understand the detector baseline (no sample in cell) on the chart recorder is achieved with maximum transmitted UV energy passing through the flow cell striking the photo-tube. When a sample flows through the flow cell, an amount of the UV light is absorbed causing a decrease in transmitted energy to the photo-tube. This decrease in UV energy on the photo-tube is seen as a negative going peak on the chart recorder. The negative going peak implies that a sample has absorbed an amount of the UV light causing a decrease in the total transmitted light to the photo-tube.

The Electrometer Assembly converts the signal from the photo-tube into a calibrated electronic signal. This electronic signal, by the use of an interface board, is viewed on a recorder. The electronic signal from the Electrometer is calibrated to industry standard ($1V/A_{1cm}$). This calibration is achieved on the interface board.

3.2A. Optical System Operation

Light energy is supplied by the deuterium (D2) lamp and is reflected by the source mirror (M1) which is part of the 3 way mirror assembly, to the field lens. Before arriving at the field lines, the beam goes through a square mask which defines the light beam, the beam is then passed to the filter assembly (see Figure 3-2).

The filter assembly is positioned automatically by the selection of the wavelength with the wavelength drive mechanism. The filter changes when the wavelength reaches 350 ±25 nm or 550 ±25 nm, and consists of 2 filtered segments and one unfiltered segment.

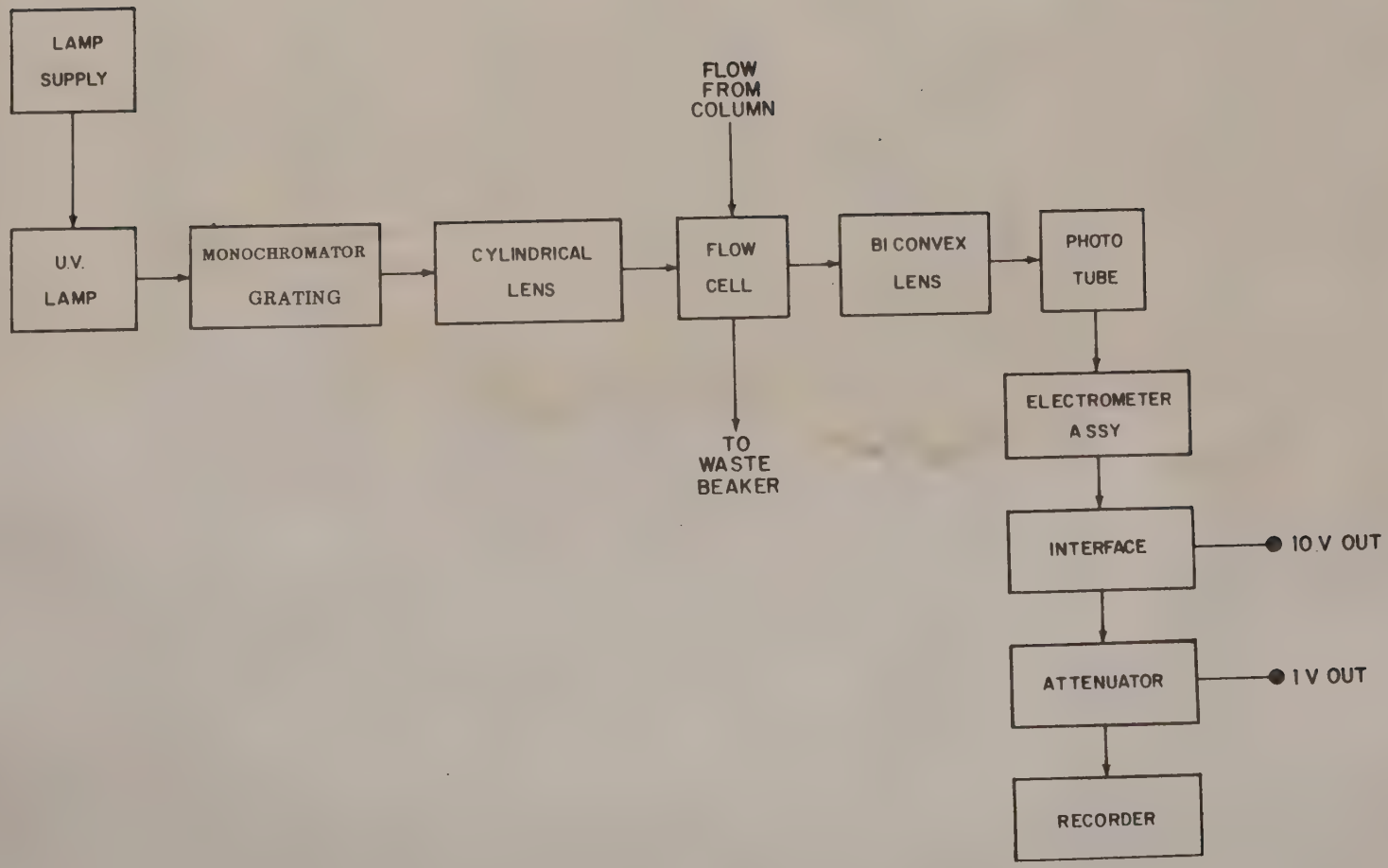

Figure 3-1 - LC-75 Detector Block Diagram

After leaving the filter assembly the light beam is then fed to the field lens and passes through the entrance slits. The size of the entrance slits determine the amount of light transmitted to the grating. Once passing the entrance slits the light beam strikes the collimating mirror (M2) and directs the collimated light to a rotatable reflective grating (M3) that converts the light beam into a spectrum depending on the angular position of the grating. A portion of the spectrum is reflected back to the collimating mirror M2 and then through the exit slits. The size of the exit slit determines the spectral band width.

In passing through the exit slits, only that part of the beam representing the selected wavelength of the monochromatic light is passed. The monochromatic light progresses through another mask to a folding mirror (M4). This mirror projects an image of the exit slit into the sample flow cell via the flat mirror M5 and the cylindrical lens. M4 and M5 are also part of the 3 way mirror assembly. The cylindrical lens focuses the projected exit slit image into the sample flow cell.

The sample within the flow cell absorbs a characteristic amount of light and transmits the balance to the photodetector. The photodetector converts the light energy into a proportionate amount of electrical energy. From this point on, the electrical signal, representing the sample value, is conditioned and amplified by various electronic circuits. The electrical signal is eventually applied to the output terminals for use with other data handling devices.

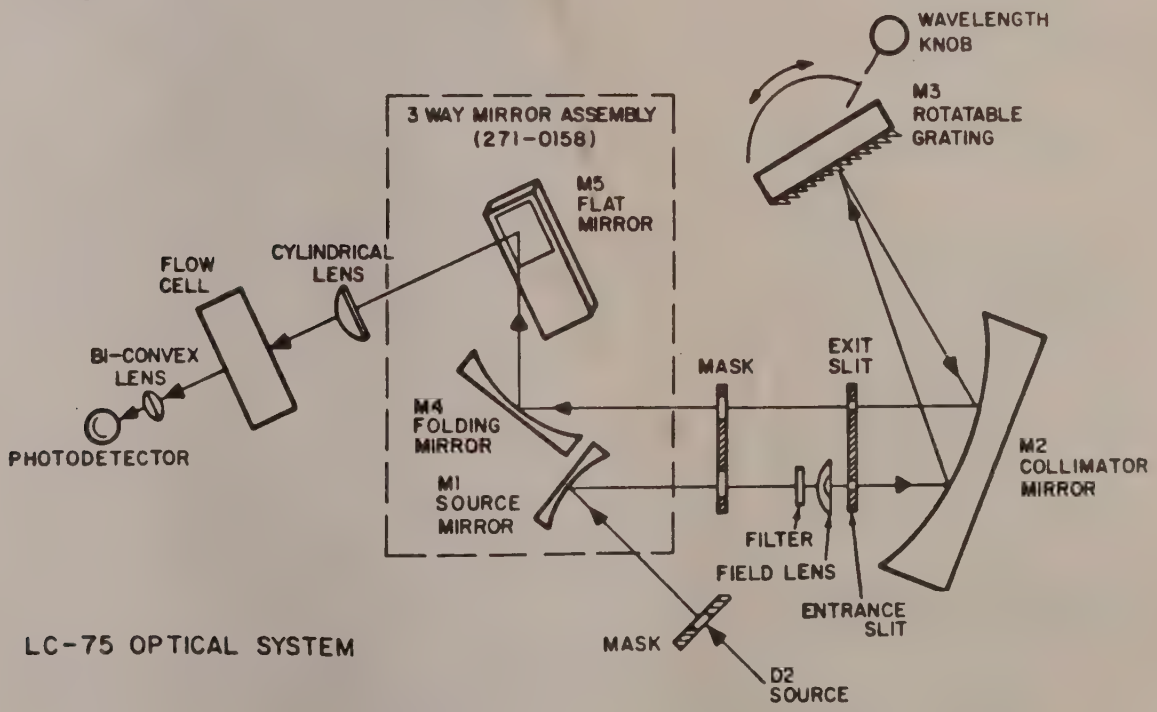

Figure 3-2 - LC-75 Optical System

3.2B ELECTRONICS

1. Low Voltage Power Supply/UV Lamp Driver Theory of Operation

The low voltage power supply is divided into 4 sections. (See Figure 3-3.)

a) +15V Supply

IC1 is the regulator with Q1 and Q2 pass transistors supplying +15V to the distribution lines.

b) UV Lamp Filament

On initial turn-on, the filament voltage to the UV lamp is 11VAC. The 11VAC times out afer 15 seconds, then the filament voltage is reduced to 8VAC. The timing circuit of IC3 controls the selected filament voltages thru SCR1 and SCR2. The higher filament voltage is used to heat the lamp more rapidly.

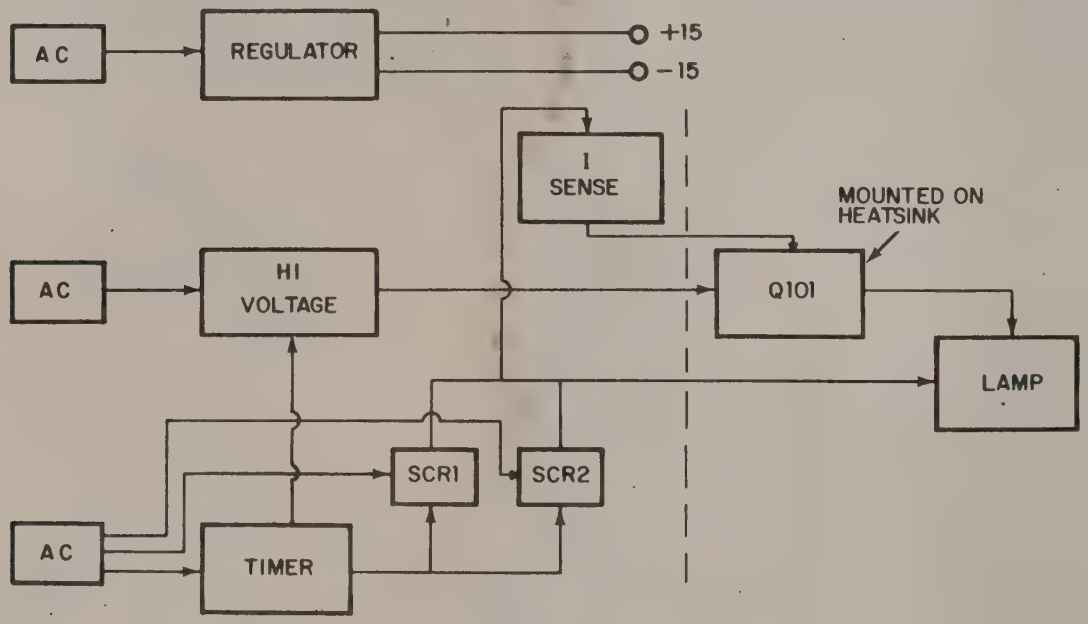

Figure 3-3 - Low Voltage Power Supply/UV Lamp Block Diagram

c) High Voltage Power Supply

During the timing cycle of IC3, relay K1 energizes for 5 seconds causing 600VAC (lamp starting voltage) to be applied to the lamp. When relay K1 de-energizes, the lamp voltage drops to the normal operating voltage of approximately 120V.

d) Current Sense Circuit

The current sense circuit, comprised of IC2 and Q3, monitors the current thru Q6. The circuit varies the current up or down depending on what it senses.

3.2C Low Voltage Power Supply/UV Lamp Driver Circuit Description (see Figure 3-3)

This circuit is comprised of the low voltage power supply and UV power source. The power supply has 4 major functions:

a) Provides high heater current to lamp prior to firing.
b) Supplies high anode voltage for firing lamp.
c) Supplies lower anode voltage after firing.
d) Provides regulation for changes in lamp intensity.

The normal anode operating voltage, of approximately 120VDC, is developed by bridge rectifier C3 and filtered by C9, C10 and R8.

Part of the starting voltage (480VDC), for firing the lamp, is developed by bridge rectifier CR2. The 480VDC, added in series with the 120VDC, provides 600VDC anode voltage when relay K1 is energized.

During warm up of the lamp, high heater current is provided by the 12VAC developed across pins 5 and 6 of T101. After the lamp is fired, the filament voltage is reduced to 7.5VAC. This voltage is developed across pins 1 and 2 of T101.

The anode of the lamp is connected to pin 4 of J402; the lamp heater is connected between pins 5 and 3 of J402. When the instrument is turned on, pin 5 of IC3 is high and pin 9 of IC3 is low. The high on pin 5 turns on Q5 and CR15.

The low collector of Q5 keeps pin 8 of IC3 low. Pin 9 of IC3 stays low until pin 8 of IC3 goes high. With CR15 turned on, both optical coupler IC5, and Q6 are turned on. With Q6 turned on, the low collector voltage keeps optical coupler IC6 off.

With the optical coupler IC5 on, the ac filament voltage is as follows: pin 5 of J401 thru SCR2 to pin 2 of J402, thru the lamp filament back to pin 6 of J401. The SCR is gated by rectifying the filament voltage with CR4 when IC5 is conducting and feeding the returned dc to the SCR gate. While SCR2 is gated, a filament voltage of 11VAC is applied to the lamp.

The ac, flowing through R31 causes a voltage drop across it that turns on optical coupler IC4 for each positive alternation of the ac cycle. The resulting IC4 pulses are integrated by C13 which after approximately 15 seconds, builds up enough charge to make pin 5 of IC3 go low. The charging of C13 inputs to the threshold of pin 2 of IC3 which is reached by the time constant of R28 and C13 (5 seconds). Because 1/3 of the alternating positive edge turns on IC4, 15 seconds timing is achieved. If the ac signal is 2V on the positive half cycle, and the optical coupler diode turns on at .7V, then only 1/3 of that voltage charges C13. When pin 5 of IC3 goes low, this turns off CR15 and Q5. When Q5 goes off, its collector goes high and triggers pin 8 of IC3 which causes pin 9 of IC3 to go high.

Since pin 9 of IC3 is now high, it turns on CR17 which serves the same function as CR15 and keeps optical coupler IC5 and Q6 turned on; optical coupler IC6 is turned off.

The high from pin 9 of IC3 also turns on CR16 and energized relay K1. When the relay is energized, the switch between pins 2 and 5 of the relay are closed, passing the high firing voltage of 597.8VDC to the lamp anode. This turns on the lamp. After about 5 seconds, determined by R19 and C16, pin 12 of IC3 threshold is reached and pin 9 of IC3 goes low, thus turning off CR16 and CR17.

When CR17 turns off, Q6 begins to go toward cut-off as C18 discharges through the parallel resistances of the Q6 base emitter junction and R26 in series with R25. There is a 8msec. delay created by C18 to make sure SCR2 is fully off before SCR1 turns on. This insures that both SCR's are not on at the same time. Now that SCR1 is turned on, it switches the lamp heater supply to the 7.5VAC T101 winding.

With the optical coupler IC5 now turned off, the current path described previously is no longer available. A new current path has been developed by the turning on optical coupler IC6, (using the 7.5VAC windings of T101 at J1 pins 6 and 7).

With the optical coupler IC6 on, the ac filament voltage path is as follows: pin 7 of J401 thru SCR1 to pin 2 of J402, thru the lamp filaments and back to pin 6 of J401. SCR1 gating is identical to SCR2 gating. The filament voltage is rectified by CR5 when IC6 is conducting and feeding dc to the gate of SCR1. The filament voltage to the lamp is approximately 8VAC.

When pin 9 of IC3 goes low, CR16 is turned off. K1 de-energizes thus opening the switch between pins 2 and 5 of the relay. This assures that no anode voltage source other than the 117.8V affects the lamp, not even a negligible one.

The complete high voltage current path is as follows: From ground through R9 to the junction of CR8 and CR9, the two diodes CR8 and CR9, through the lamp to the anode. From the anode through CR12 and CR11 which isolate the starting voltage from the collector of Q101, through the fuse F102 (5A, 125V) to the Q101 collector, and from the Q101 emitter to the high side of C9.

In order to keep the energy output of the lamp constant, it is necessary to carefully regulate the lamp current. This is done by using the OP Amp IC2 and Q3 to control the condition of Q101 through which the lamp current passes. R9 is a current sensing resistor. The voltage at TP4 should be approximately 500mv at 250ma which acts as an input to the inverting input of IC2, pin 2. Any changes in the lamp current causes change in the voltage across R9. These changes are compared by IC2 which controls the conduction of Q3. The Q3 conduction controls Q101. For example, suppose that the current starts to rise, this causes a more positive voltage at TP4, which yields a less positive voltage at the output of pin 6 of IC2. This results in a lower base voltage at the NPN transistor Q3. Q3 conducts less and provides less base current for NPN Q101. The result is that Q101 conducts less and the lamp current is brought to its original value. F102 is a fast blow fuse to protect Q101 and IC2 should either the lamp short or R9 short to ground by accidential probing. CR6 is a 6.2V Zener diode used to supply a reference voltage to IC2. They are inputted into the non-inverting input of IC1, pin 3 which acts as a reference. R12 is adjusted to set the current thru the lamp by adjusting the voltage from TP4 to ground to .5V.

CR21 (across R15) filters out high frequencies generated by the UV lamp. If the bandwidth was not limited by this capacitor, R9 would sense the high frequencies and effect the output of pin 6 of IC2 which would result in excessive drift. CR21 also prevents IC2 from going into oscillation.

Low Voltage Power Supply +15V

CR1 is a full wave bridge rectifier which provides a raw DC voltage of 21V at .5A to the dual tracking voltage regulator IC1, Q1 and Q2. Q1 and Q2 are two external transistors used to boost the supply currents above 200ma to 300ma. The power supply is short circuit current limited to 300 ma by R3 and R4.

C1 and C2 are ripple smoothing capacitors. C3 and C4 are noise suppression capacitors which send any high frequencies to ground. R2 and R1 are biasing resistors for the series pass transistors Q1 and Q2. C5 and C6 are used to narrow the bandwidth to prevent oscillation of the regulator. C7 and C8 are used to filter out 60 cycle ripple. They are a low frequency rated up to 1 KHz. C19 and C20 are high frequency filters.

3.2D Electrometer Assembly Theory Of Operation (0271-9114) Figure 3-4

The Electrometer Assembly is comprised of four parts.

1. Sample Electronic Circuit
2. Reference Electronic Circuit
3. Comparator Stage
4. Filtered Amplifier

1. Sample Electronics

When a sample is present in the flow cell, a portion of UV light excites the photo-tube. The photo-tube current decreases representing the sample in the flow cell. This current is applied through IC1, IC2 and a log conversion transistor Q1. This log voltage, which represents the sample in the flow cell, is applied to the non-inverting input of IC4A.

2. Reference Electronics

Since the LC-75 Detector is a single beam instrument, an electronic reference is required to zero the baseline with no sample in the flow cell. An attentuator is provided to keep the sample signal on the flow chart.

A Zener diode develops the starting reference voltage. The reference voltage, from the Electrometer Assembly, is applied to the Coarse Adjust Assembly (0271-9153). The reference voltage is then fed to a binary attenuator which selects how much of the reference votlage is required. This voltage is then applied back to the Electrometer Assembly through IC3 and Q1 where a log function is performed. The log voltage which represents the selected reference voltage, is fed to the non-inverting input of IC4B.

3. Comparator Stage

The log representation of both the sample and reference voltage is now present at the input of IC4 (A and B). IC4 is the comparator stage.* The comparator feeds a differential amplifier before applying the signal to the final output stage. When both inputs to the comparator amplifier are zero, the output is zero. This output represents $1V/A_{1cm}$. The baseline zero is set in the above manner.

*Also referred to as Common Mode Rejection Rate Amplifier or Instrumentation Amplifier.

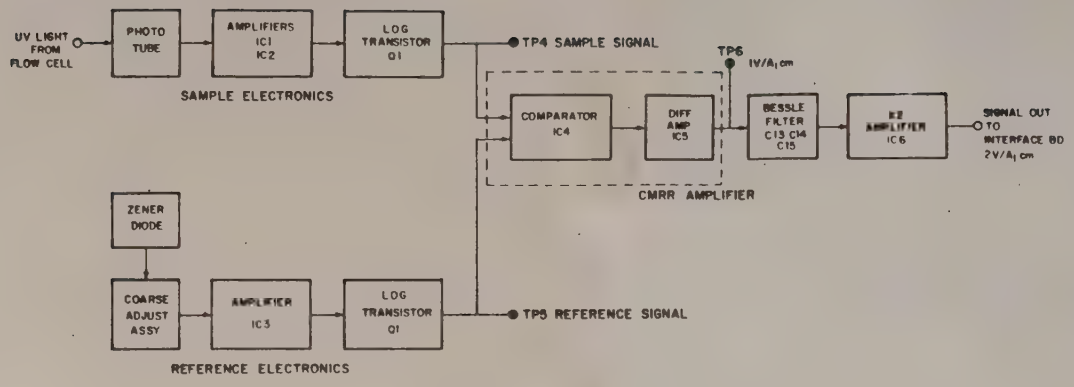

Figure 3-4 - Electrometer Assembly (0271-9114) Block Diagram

4. Filter Amplifier

The signal from the comparator stage represents only what is in the flow cell. This signal is fed through a filter configuration known as a Bessel Filter. The filter is a low pass filter whose amplitude remains constant and is not affected by changes in frequency. The final stage (IC6) is a X2 amplifier whose output represesnts $2V/A_{1cm}$.

3.2E Electrometer Assembly Circuit Description

1. Sample Electronics

The anode voltage for the photo-tube is developed by 6.2V Zener diodes in series across the -15V line resulting in -12.4V anode voltage. When light strikes the photo-tube, a portion of the -12.4V is supplied to terminal E8, the non-inverting input of IC1, pin 3.

The output of IC1 (unity gain buffer amplifer) is the feedback loop to the non-inverting input and is tied to ground.

IC1 output is applied to integrator IC2. The output of IC2 has 1/2 of Q1 (dual AD 820) in its feedback loop; Q1 develops the log function. The output voltage at TP4 is such that every decade of changes (created by the photo-tube), applied at IC1, results in a 0.06V change.

One hundred percent T to ten percent T is one decade of change. One hundred percent T to one percent T is two decades of change and one hundred percent T to 0.1 percent T is 3 decades of change.

With no sample in the flow cell, maximum UV light strikes the photo-tube, thereby generating a voltage at TP4 (through the sample electronics).

When a sample is present in the flow cell, the amount of light to the photo-tube decreases (absorbed by the sample), thereby decreasing the voltage at TP4. Whenever the voltage at TP4 decreases by 0.06V, it represents one decade of change or one absorbance unit.

The maximum output at TP4 is 5 1/2 decades of change (photo-tube limitations). A 5 1/2 decade of change is equivalent to .33V (5.5 x .06 = .33). When the final stage of the Electrometer is calibrated, .35 V is used for the calibration voltage.

2. Reference Electronics

The major electronic components of the Reference Electronics are the IC3 amplifier and the second half of dual transistor, Q1, where the reference voltage log conversion is performed.

A negative voltage is used to generate the reference voltage -6.2V. The -6.2V is developed by Zener Diode CR1 across the -15V line. This -6.2V is fed off the board to the Coarse Adjust Board (0271-9153). On the Coarse Adjust Board, the -6.2V is fed through a binary attenuator chip (CDD727) and is capable of being attenuated from -6.2V to -.006V., which again is fed back to the Reference Electronics on the Electrometer Assembly, IC3, pin 2. The Coarse Adjust potentiometer determines the path of the -6.2V through the binary attenuator IC.

Table 3-1
Coarse Adjust Voltage Chart

POSITION	WIPER VOLTAGE
1	-.62
2	-3.1
3	-1.55
4	-.755
5	-.3875
6	-.1937
7	-.0968
8	-.0484
9	-.0242
10	-.0121
11	-.0060

By viewing the voltage chart (Table 3-1) notice that each position represents a voltage division by 2 of the previous position.

The reference electronics is adjusted by use of the Coarse Adjust potentiometer so that the voltages at TP5 and TP4 are equal when there is no sample present in the flow cell. TP4 and TP5 are the inputs to the next stage of the Electrometer Assembly, the Instrumentation Amplifer.

3. Instrumentation Amplifer (Figure 3-5)

An instrumentation amplifier (also called Common Mode Rejection Rate Amplifier), is an amplifier that has exact inputs on the first stage comparators and results in an absolute zero output on the final stage differential amplifier. Absolute zero means less than 1 μv.

The Instrumentation Amplifier (IC4) amplifies the input voltages at TP4 and TP5 by 16.66 times before feeding the output stage IC5. The gain of IC4 is also temperature controlled by thermal resistor R26 which is mounted next to the dual log transistor, Q1.

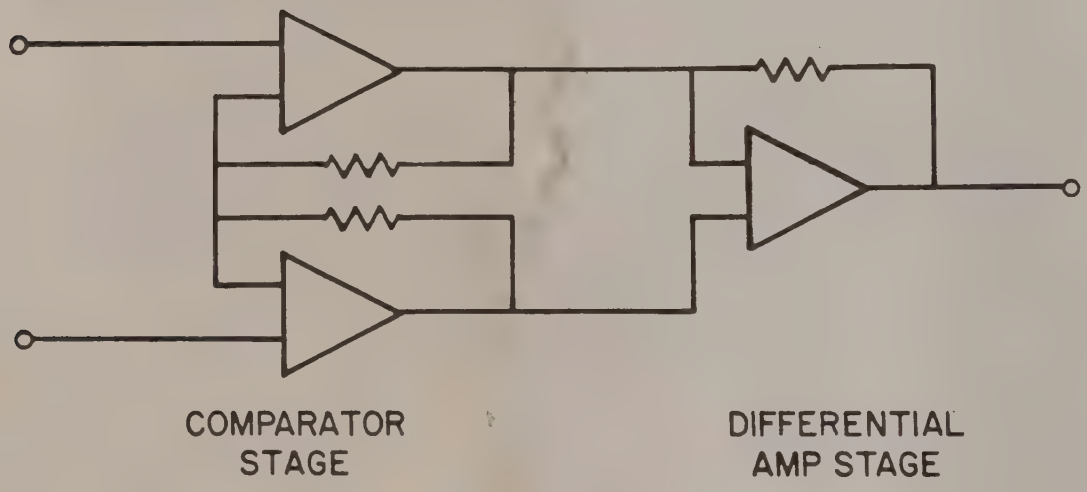

Figure 3-5 - Basic Instrumentation Amp Circuit

When the voltages at TP4 and TP5 are equal, the output of IC5 (which is TP6) is zero. When the photo-tube signal changes (because of a sample present in the flow cell) a change occurs at TP4. Remembering that every decade of change results in a 0.06V change (log function of Q1) at TP4. Every decade of change (one absorbance unit per decade) produces a 1V change at TP6. (IC5 output). There is 1V per absorbance unit present at TP6.

The TP6 voltage is applied to the final stage of the Electrometer Assembly, IC6, which is a X2 amplifier with a Bessel filter input arrangement.

A Bessel filter is described as a low pass filter where amplitude remains constant and is not affected by frequency changes.

This particular arrangement cuts off any frequency above 3Hz and keeps the gain at the input of IC6 constant while cleaning up any noise generated by the electronic components in the Electrometer Assembly. The Bessel filter components are C13, C14 and C15. All 2.0 μf capacitors see Figure 3-6).

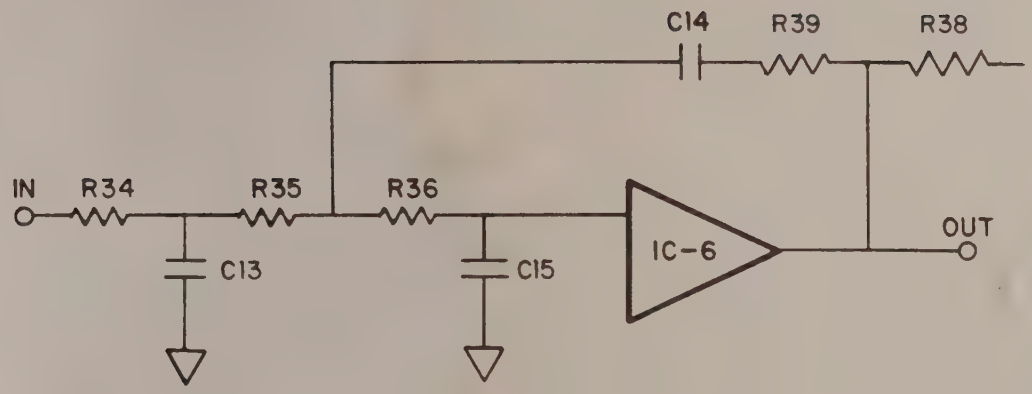

Figure 3-6 - Re-Drawn Bessel Filter Arrangement

The final stage gain is derived from the three input resistors R34, R35 and R36. These resistors, in relationship with the feedback resistor R39, produces a total resistance of 285.7K. The diodes CR5, CR6 and CR7 make up a protection circuit for IC6.

The output of IC6 which is 2X the input produces 2V per absorbance unit. This output feeds E12 and E13 which is applied to the input of the Interface Board 0271-9074 on the 75 Detector or to the Analog Board 0271-9134 on the Auto-Control System.

3.2F Interface And Attenuator Circuit Description

Read the analog interface theory of operation first. The log amp signal enters the interface board on J501 pin 7 (SIG+) and pin 2 (SIG-). This input signal is monitored by the front panel meter M701 via R4 (current limiter) and is fed to the non-inverting input pin 3 of IC2 via R1 and R2. The input signal is noise suppressed by C7, C8 and C9.

The gain of IC1 is determined by R1, R2 and R6. The feedback is looped to the inverting input pin 2 to track the non-inverting input. With R2 adjusted for zero ohms, IC1 has unity gain. Due to the Inernational Standardization of pathlength, the gain is adjusted to set the conversion from 6 mm to 1 cm (a reduction gain of 0.8333), by R2.

R5 is used for the offset adjust of IC1. R701 "FINE ADJUST" and R3 (current limiter) provide a null voltage which when summed with the input signal, can be adjusted to set IC1 output to zero as long as the front panel meter needle is in the green region. This adjustment has no effect on the log amp signal.

CR3, CR4, CR5 and CR6 are used as protection diodes for the CMOS, FET IC1. CR3 and CR6 are input overvoltage protect which guard against high voltage spikes greater than $\pm$15 volts. CR4 and CR5 are clamping diodes to assure that the non-inverting and inverting inputs of IC1 are less than 0.6V.

The output of IC1 is fed to three places:

1) Attenuator board via 14 conductor ribbon cable. The attenuator splits the signal to two other places:

   a) To the REC + terminal on TB1.

   b) To the 1V terminal on TB1 via 10:1 divider within the attenuator chip.

2) Direct to the 10V terminal on TB1.

   SP1 on the attenuator board selects the REC + voltage level. They can be 10mV, 2.5mV or 1mV). From SP1, the signal is fed to the attenuator chip (which is divided by 2). The output is dependent on the particular pushbutton that is depressed. One of the attenuator buttons has to be depressed so the signal may be felt at the REC + terminals of TB1 via R2. The output is ABS_{1cm} x 0.01, example - the 512 button is representative of 5.12 Absorbance Units Full Scale (A.U.F.S.).

   When pins 1 and 2 are shorted together by means of a remote marker switch R7 on the interface board (along with R3 and R1 from the attenuator board) form a voltage divider network from -15V to ground. Depending on the adjustment of R1 of the attenuator board, a negative offset can be introduced to the recorder output terminals on the REC - side. The remote contact closures time should be very small so as to put a negative blip on the recorder to identify injection point or in the case of autocontrol, wavelength positioning.

4 MAINTENANCE AND TROUBLESHOOTING

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4 MAINTENANCE AND TROUBLESHOOTING

4.1 GENERAL PRECAUTIONS

1. Switch the POWER OFF, and unplug the AC line cord whenever it is necessary to lift the LC-75 cover.

   Warning: Do not operate the LC-75 when the cover is lifted.

2. Whenever the cover is lifted and the lamp is on, wear eye protection.

   Warning: Never look directly at the lamp when it is on. Wear suitable eye protection in the form of glass safety glasses to prevent serious and irreversible damage to the eyes when servicing the deuterium lamp.

3. Allow the lamp to cool before performing service. Wear thermal protective gloves as necessary to avoid burning the hands.

4.2 TEST EQUIPMENT AND SERVICE AIDS

The following is a list of test equipment and service aids required to service the LC-75 Detector and Autocontrol.

1. Test Equipment:

   a) Oscilloscope
   b) 4 1/2 Digit DVm

2. Service Aids:

a)	Service Legs	0168-9034
b)	30 cc syringe	0087-9078
c)	Test Cover Flow Cell	0271-1298
d)	PTFE Tubing (3 ft)	0250-6495
e)	Luer Fitting	0089-1338
f)	Restrictor Coil	0254-0843
g)	Appropriate Hand Tools	
h)	X10 Loop	5A-108-10
i)	File	0990-7296
j)	Mild Soap Solution	
k)	Cotton Balls	
l)	Back Pressure Regulator (55 PSI)	0990-3598
m)	Back Pressure Regulator (100 PSI)	0990-3599
n)	Epoxy	0990-8399

3. Service Data Bulletins:

   a) 271-2
   b) 271-3
   c) 271-6
   d) 271-7
   e) 271-11

4.3 ALINGMENT PROCEDURES

4.3A Deuterium Lamp

Align the deuterium lamp whenever the lamp has been disturbed or replaced. Make certain that the recorder is connected and operating.

1. Turn the POWER switch ON. Make certain that the solvent flow through the cell is stopped.

2. Wear suitable eye protection in the form of safety glasses to prevent damage to the eyes and thermal protective gloves to prevent burns.

3. Set the analytical WAVELENGTH to 240 nm. Set the $ABSORBANCE_{1cm}$ selector to X8. Zero the LC-75 and the recorder. Set the recorder baseline at 50 divisions.

4. Wait 30 minutes to allow the lamp to warm up.

5. Use only the Allen wrench provided with the detector to adjust the lamp mount. Adjust in a linear direction until the maximum energy is observed on the energy meter and the recorder.

6. Adjust the tilt until the energy meter is at its maximum and the recorder pen indicates minimum absorbance.

7. Align the cell.

4.3B Flow Cell

Perform the following alignment procedure whenever the lamp has been removed or replaced. Do the procedure in a room which is dimly lit.

It is not necessary to realign the cell when the sample cell alone has been removed.

1. Plug in the AC line cord if this has been disconnected. Turn ON the POWER switch. Set the WAVELENGTH control to 240 nm. Set the $ABSORBANCE_{1cm}$ selector at X8. Wear glass safety glasses to prevent damage to the eyes. Zero the recorder and LC-75 to recorder 50 divisions.

2. Remove the cell cover. Change the WAVELENGTH control to 190 nm. Keep the $ABSORBANCE_{1cm}$ selector at X8. Insert a 3/32-in. Allen wrench (P-E Part No.0990-7271) in the horizontal adjustment hexhead socket. Be sure the wrench is inserted "straight". Observe the recorder pen and the energy meter. Make minute adjustments by rotating the wrench and note if the energy level goes up or down. The object is to obtain the minimum amount of absorbance and maximum energy possible. Increasing energy drives the pen down scale opposite to peak deflection.

3. At the same time adjust the vertical screw until maximum energy is obtained. Try to make adjustments by rotating both screws rather than by moving one screw a large amount. Try to avoid reaching the limits of screw travel.

4. Reconnect the pump line to the flow cell inlet. Set the pump flow rate for proper flow depending on system configuration.

5. Check for any possible leaks that may occur within the flow cell interface section.

6. Replace the cell cover when the cell alignment is complete. Replace the cover, securing screw and blanking cap.

4.4 VOLTAGE CHECKS AND ADJUSTMENTS

4.4A Power Supply/D2 Lamp Driver Voltage Checks (0271-9120)

1. Check ±15 Vdc for correct levels and stability.

2. Check the voltage across R9, between TP4 (+) and TP8 (-) with a multirange recorder.

   a) After a 30 minute warm-up, adjust R12 if necessary for .500 ± .02 V.

   b) Monitor the voltage across R9 (D2 lamp current sensor) for drift or noise.

   c) Check that the voltage across R9 does not fluctuate more than ±1.1112 volts. If it does, then the D2 lamp current circuit (CR2 and CR3, IC2, Q3, Q101, D2 lamp and their associated components) are at fault, change as required.

3. D2 lamp voltages

   a) Check the D2 lamp filament voltage between the two blue leads.

      1) Voltage with D2 lamp unlit, approximately 12.5 VAC.

      2) Voltage with D2 lamp lit, approximately 7.5 VAC.

   b) Check the D2 lamp anode voltage between the red lead (+) TP8 (-) or ground.

      1) Voltage before K1 relay energies approximately 120 VAC.

      2) Voltage after K1 relay energies jumps to 600 Vdc then quickly drops to approximately 80 Vdc and stabilizes.

4.4B Electrometer

1. Replacement and/or alignment of components to the left of SP-5 and SP-6 (schematic 0271-9110) is not recommended. The only alignment on the electrometer is to the right of SP-5 and SP-6, and the procedure for these follows.

a) Set jumpers as follows: (see Figure 4-1)

1.	SP-4	B-C
2.	SP-5	B-E
3.	SP-6	B-E

b) Connect DVM to TP7 (-) and TP8 (+), adjust R23 for zero (±0.03mv).

c) Connect DVM to TP6 (+) and TP2 (-), adjust R32 for zero (±0.03mv).

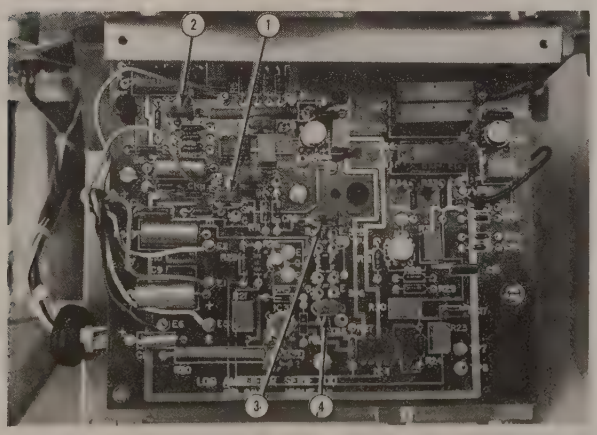
d) Connect DVM between E12 (+) and TP2(-), adjust R37 for zero (±0.1 mv).

e) Move jumper SP5 and SP6 to the C-F position, adjust R30 for zero (±0.01mv) at E12 (+) to TP2(-).

f) Return jumpers to normal configuration as follows:

1.	SP-1	A-B
2.	SP-2	A-B
3.	SP-3	A-B
4.	SP-4	A-B
5.	SP-5	A-D
6.	SP-6	A-D

g) Replace electrometer cover and secure with the two 6/32 x 5/16 inch binding head screws.



1) SP-1

2) SP-2

3) SP-5

4) SP-6

Figure 4-1 - Log. Amp. Board

4.5 OPTICAL CLEANING PROCEDURES

4.5A D2 Lamp (0271-1340)

Caution: D2 lamp when lit is extremely hot. Do Handle with Care.

1. Removal

   a) Turn off the LC-75.

   b) Unfasten the three wires of the D2 lamp from the terminal board (0998-1930). (See Figure 4-2.)

   c) Unfasten the D2 lamp locking assembly.

   d) Remove the magnet bracket (0271-0157) with needle nose pliers.

   e) Remove the D2 lamp by holding the wires, lift up and away.

2. Inspection - inspect the lamp as follows:

   a) Inspect the D2 lamp for loose particles of ceramic within the glass envelope.

   b) Replace D2 lamp if particles are detected.

   c) Clear the window area of the D2 lamp of these particles, if new lamps are unobtainable.

   d) If baseline appears cyclic the lamp may be old and in need of replacement.

   e) Check the D2 lamp Teflon seal (0271-1277). The seal is rather fragile and if old may split when changing D2 lamp. A broken seal degrades the performance of the detector and should not be used. Carry spares.

   f) Replace, if required, the two socket head adjusting screws and lock nuts with nylok type screws (0990-7495).

3. Cleansing - Clean the ozone window and D2 lamp windows with acetone and a Q-tip before reinstalling the D2 lamp. (See Figure 4-3.)

4. Reinstallation - install the D2 lamp as follows:

   a) Place a good Teflon seal (0271-1277) on lamp holder assembly.

   b) Install the D2 lamp, making sure it is firmly on the corner mounts of the lamp housing (0271-0166).

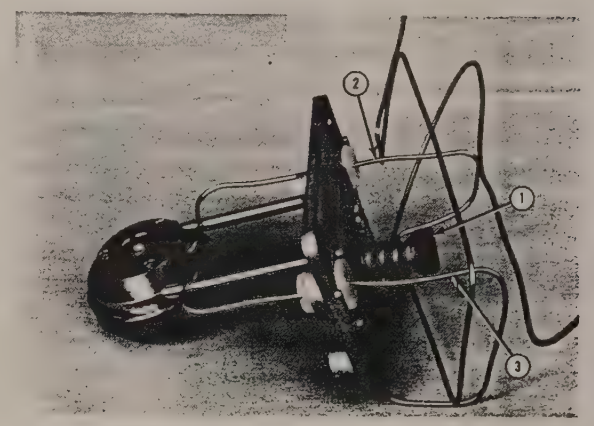
   c) Assure proper placement of (Teflon) seal.

   d) Check the magnet bracket (0271-0157) for proper placement, (four pins on bracket against the lamp and the extruding tab of the bracket up against the bottom of the lamp).

   e) Fasten the D2 lamp locking assembly.

1) D2 Lamp Quartz Window
2) Ozone Quartz Window
3) D2 Lamp Teflon Seal
4) D2 Lamp Wire Terminal

Figure 4-2 - D2 Lamp Assembly



1) Securing Thumb Screw
2) Inlet Line
3) Outlet Line

Figure 4-3 - Flow Cell Assembly

5. D2 Lamp Assembly Checks

   a. Assure the D2 lamp assembly moves freely when:

      1) Pressed on the side of the assembly.

      2) The bottom of lamp is lifted in opposite direction of spring tension.

6. Energy Peak Adjustments

Turn the LC-75 power on and allow a 30 minute warm-up. Adjust the D2 lamp for a maximum energy peak, at a wavelength of 240nm and attenautor to X8.

Adjust, with a 3/32 Allen wrench, the front and back alignment set screws one at a time until a maximum energy peak is obtained.

4.5B Flow Cell

Dirty flow cells produce excessive noise and drift. The majority of dirty flow cells can be cleaned without removing them from the detector by pumping a sequence of solvents through the flow cell.

If this cleaning procedure doesn't remedy the noise and drift problem, then the flow cell must be removed and inspected.

Materials Required:

Distilled and filtered water
Isopropyl alcohol
Nitric acid
Ammonium hydroxide (NH_4OH)

Cleaning the Flow Cell:

a. Remove the column from the system and bypass it with clean tubing. Use 0.015-in. I.D. tubing from the pump to the flow cell inlet but do not connect it to the inlet. Instead direct it to a beaker.

   Note: When you are connecting or removing tubing from the detector inlet or outlet unions, use two wrenches to prevent any turning of the unions. Excessive turning of the detector inlet and outlet unions may result in a severed detector line.

b. Change the pump reservoir to isopropanol and begin to pump approximately 20 mL of the isopropanol into a beaker.

c. Connect the tubing to the flow cell inlet.

d. Set the pump flow rate to 3 mL/minute and pump the following sequence of solvents for five minutes each. DO NOT EXCEED THE 2000 PSI LIMIT ON THE FLOWCELL.

   Caution: Use standard laboratory procedures and extreme care when handling strong acids and bases.

1) 100% filtered, distilled water
2) 10% ammonium hydroxide/water solution
3) 100% filtered, distilled water
4) 20% nitric acid/water solution
5) 100% filtered, distilled water

e. Pump isopropanol to prepare your system for: (1) any mobile phase; (2) Short-Term Shutdown; or (3) Long-Term Shutdown

1. Removal and Inspection

a) Remove the cell compartment cover.

b) Disconnect the inlet and outlet lines from the flow cell. Disregard if new style flow cell (0271-0338) is used.

c) Unscrew the thumb screws which secure the lines to the casting; remove the lines from the casting.

d) Loosen knurled thumb screw on top of the flow cell (See Figure 4-3.)

e) Lift sampling cell straight out of the interface.

f) Inspect cell windows for obvious problems such as cracks, foreign material or extrusions of the gasket into the optical path of the cell. If detected proceed to next section, Flow Cell Cleaning Procedure.

2. Cleaning Procedure

Materials Required:

Qty	Part No.	Description
A/R	N/A	Appropriate Hand Tools
1	0087-9078	30cc Priming Syringe
1	0089-1338	Luer Fitting
1	0254-0843	Restrictor Coil
3	0087-9439	SSI Union
3 ft. (1 meter)	0250-6495	PTFE Tubing
50ml (cc)	N/A	Filtered, Degassed, Water
30ml (cc)	N/A	Filtered, Degassed, 1:1 Solution Nitric Acid and Water
A/R	N/A	Al Foil
1	0271-1298	Test Cover

These procedures refer specifically to the LC-75, but they also work for the LC-85.

Warning: Nitric Acid is extremely corrosive, exercise caution.

Warning: In the procedures below, take care not to force too much water from the syringe into the acid. This can cause heat and possible spattering. Use the Al Foil to cover the beaker as per Figure 4-4.

a. Nitric Acid Cleaning

1) Have a qualified person mix and filter the 1:1 acid solution.

2) Blow the flow cell dry with clean, dry nitrogen, air or helium.

3) Assemble cleaning apparatus as shown in Figure 4-4.

4) Draw acid slowly into the flow cell. Do not draw acid all the way to the syringe.

5) Let the acid sit in the flow cell for about ten minutes. Never leave the acid in the cell for more than thirty minutes.

6) With gentle pressure, force the acid out of the cell. Then force water from the syringe through the cell to wash out any acid that may have clung to the surfaces.

7) Disassemble the cleaning apparatus.

8) Blow the cell dry with a gas as in step 2.

9) Verify that the cell is clean and dry by running a baseline.

10) If noise persists, then proceed to step b below.

b. Mechancial Disassembly and Cleaning of Flow Cell

1) Remove the cell compartment cover.

2) Remove cell inlet and outlet tubes where applicable.

3) Loosen the black knured thumb screw that holds the cell to the mounting plate assembly.

4) Remove the flow cell.

5) Disassemble the cell as follows:

   a. Lay the flow cell down so that the set screw heads are facing up.

   b. Place the palm of your hand under the cell to catch any pieces that may fall during disassembly.

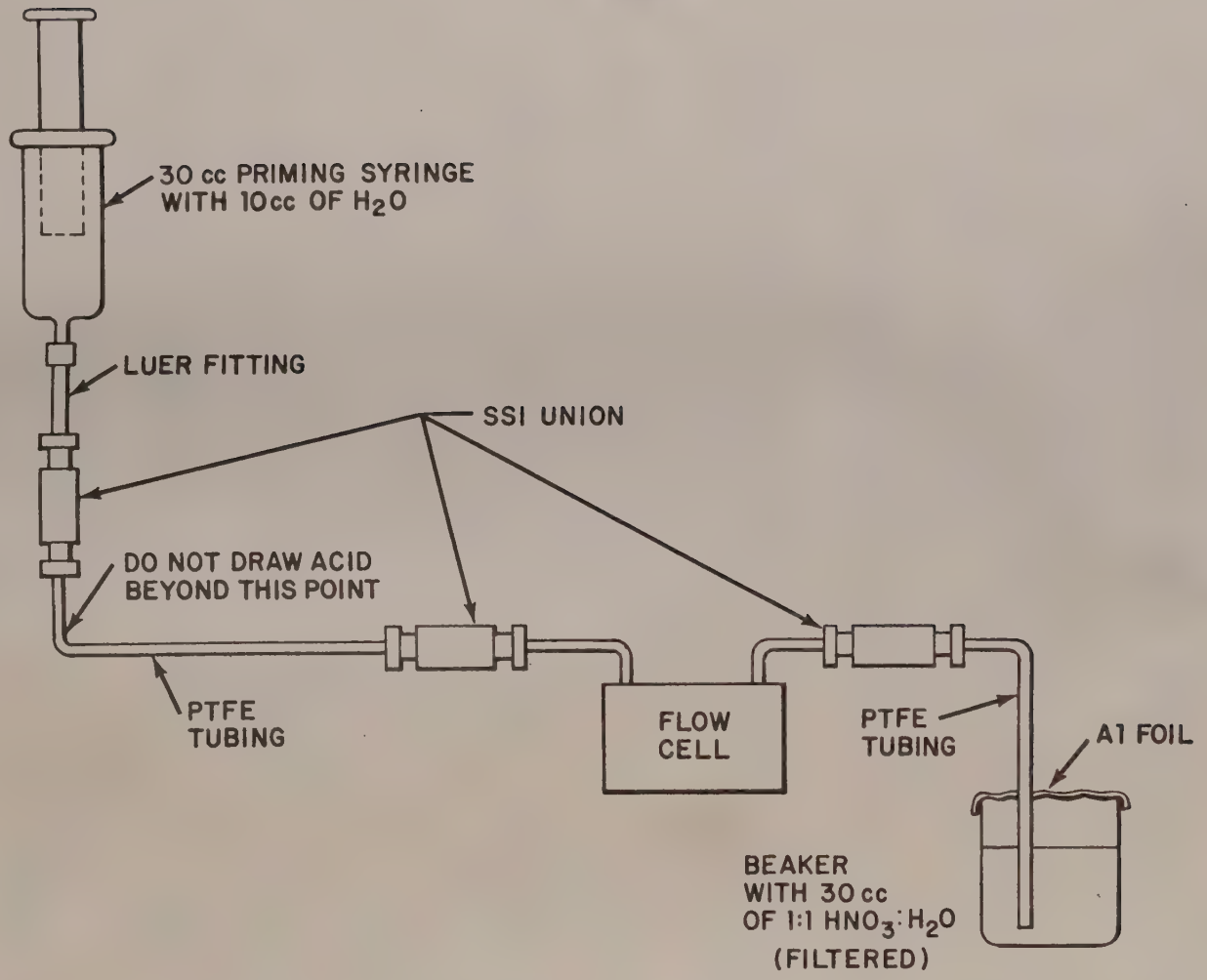


Figure 4-4 - Assembly of Cleaning Apparatus

c. Remove the three 4-40 x 1/2 Allen screws that secure the cell's retaining rings. Undo these screws one full turn at a time.

d. Remove the retaining rings.

e. Remove the three spring disk washers. The placement of the springs on reassembly is critical. Make note of the contour of each one as the cell is disassembled.

f. Remove the cell window holder, the window may or may not come off with the holder. If not, remove the window.

g. Remove the cell gasket.

h. The hand that was underneath the flow cell should have all the pieces in it except for the cell gasket.

i. Segregate the pieces.

j. Remove the last flow cell gasket.

c. Cleaning the Pieces

1) Flush the cell with ethanol, acetone, THF, methanol or other suitable solvent. Be sure to flush the inlet and outlet tubes. If stains persist, the cell can be ultrasonicated in 6 normal nitric acid ($6NHNO_3$). If acid is used, flush with distilled H_2O and then with the solvent used above.

2) Blow dry the cell with a very rapid flow of clean, dry nitrogen or other suitable gas. Be sure to dry the inlet and outlet tubes.

3) Holding the windows by the sides, use a cotton swab saturated with the solvent used above. Inspect the flat surfaces of the window of contamination and scratches. If still dirty, clean again. If scratched, replace with a new window.

4) Place the clean or new window(s) to one side on a flat piece of lens tissue.

d. Cell Reassembly

1. Place two gaskets into the cell body.

2. Place the cell retaining ring with the threaded holes in the palm of your hand, cup side up.

3. Place three of the spring washers into the cup observing a cup down, cup up, cup down sequence. This is the same sequence as the original. See Figure 4-5.

4. Place the window holder into the hole of the last spring washer.

5. Using tweezers, place the window into the window holder. Be very careful not to touch the clean window.

6. Place the flow cup side down over the pieces in the palm of your hand. Align the retaining ring holes with the holes in the flow cell body.

7. Using tweezers, place the second window onto the gasket.

8. Place the window holder over the window.

9. Now place the three spring washers over the window in a cup down, cup up, cup down sequence.

10. Place the retaining rings with the smooth through holes cup down over the washers.

11. Align all the through holes.

12. Insert and finger tighten the three 4-40 socket head screws.

13. Tighten each screw a little at a time. This brings the cell together in a very even manner and allows for maximum burst pressure.

14. Now check to make sure there is no gasket material extruded into the optical path. If there is, disassembly the cell and replace the gasket.

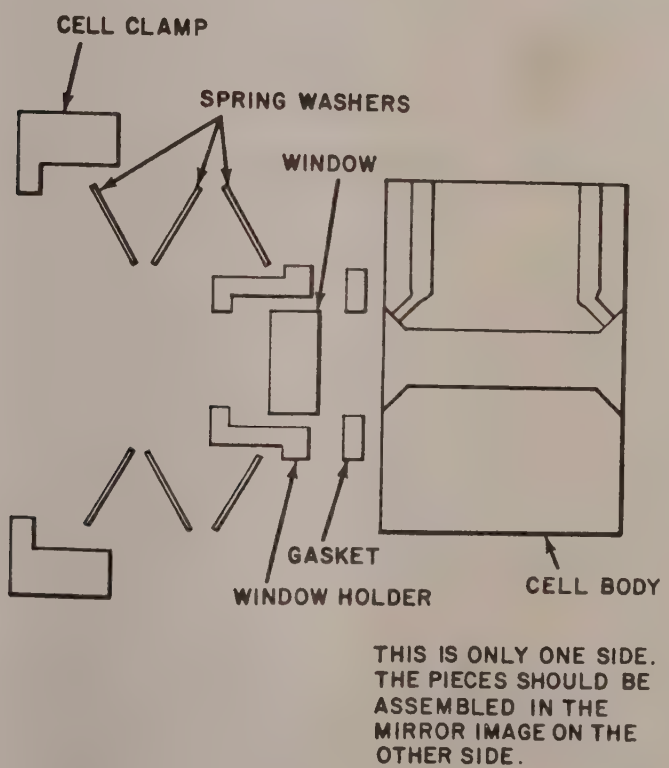

CELL CLAMP
SPRING WASHERS
WINDOW
GASKET
WINDOW HOLDER
CELL BODY
THIS IS ONLY ONE SIDE. THE PIECES SHOULD BE ASSEMBLED IN THE MIRROR IMAGE ON THE OTHER SIDE.

Figure 4-5 - Cell Reassembly

e) Pressure testing the cell

1. With the cell still outside the instrument, hook the output from the pump into the input. Connect the 0254-0843 restrictor coil on the output. Dial in sufficient flow to create 1000 psig back pressure. This corresponds to about 6.7 MPa. Let the cell flow at this rate for at least ten minutes. There should be absolutely no fluid leaks. If there are, disassemble the cell and replace the gaskets. For the LC-250A, LC-55, LC-65T, and the LC-75 with bulkhead unions on the casting, increase the flow to give 1500 psig (10.2 MPa). These cells are all rated at 2000 psig (13.4 MPa). A properly done field rebuild should yield 75% of rating (minimum). For the new LC-75 without the bulkhead unions, the pressure rating has been increased to 4000 psig (26.8 MPa). these cells should be tested to 75% of rating (minimum). Increase the flow for these cells so that the back pressure is 3000 psig (20.4 MPa). The new cell should not leak at this pressure. (See SDB 271-5.)

f) Reinstallation

1. Before installing the flow cell check that the two lenses in the interface are not cracked, chipped or missing.

2. Place the flow cell back into the interface and tighten the knurled thumb screw of the flow cell.

3. Reconnect the inlet and outlet tubing to the flow cell and secure the lines with the knurled thumb screws on either side of the interface.

4. Make sure the self-locating kinematic flow cell assembly moves freely on its two ball bearing mounts. See Figures 4-12 and 4-13.

5. Determine that the locating pins in the interface are not binding in the sides of the slots they ride on.

6. To align the flow cell proceed as follows:

   a) Purge cell with pure dry nitrogen at 5 psi.

   b) Adjust wavelength to 190 nm.

   c) Place test cover (0271-1298) over the flow cell compartment.

   d) Align the flow cell for maximum energy by adjusting the two 3/32 setscrews, front one first.

   e) Recheck D2 lamps energy peak. See Section 4.5A,6.

7. Perform the drift test. The LC-75 should have 20 divisions of less drift at 240nm. The instrument must be on for at least three hours.

4.5C Transmission Optics

1. Removal of optical bench from the LC-75.

In order to check and clean the optics, the optical bench has to be removed from the instrument as follows:

a) Remove air baffle shield (0271-1269 if the LC-75 is not mated to an Autocontrol or 0271-1334 if LC-75 is mated to an Autocontrol).

b) Disconnect the power supply D2 lamp wires from the terminal block.

c) Unsnap the two black plastic cable clamps (0998-4747) and disconnect the two connectors (P201 and P202) from the casting.

d) If LC-75 is mated to the Autocontrol, disconnect the benchmark sensor ribbon cable from the analog board. Unplug the stepper motor cable from the Autocontrol and loosen from the LC-75 cover.

e) Disconnect the inlet and outlet tubing from the flow cell. Disregard if new style flow cell (0271-0338) is used.

   1) Loosen the two knurled thumb screws on new instruments or the two socket head screws on older instruments.

   2) Remove the inlet and outlet tubing.

f) Loosen and remove the three screws (0991-0050), washers (0271-1252) and rubber spacers (0990-8547) which secure the optical bench to the structural foam base of the LC-75 and save.

g) Lift the optical bench from the instrument and place on a table or workbench.

2. Removal of optical bench from protective tub (cover) (0271-1082).

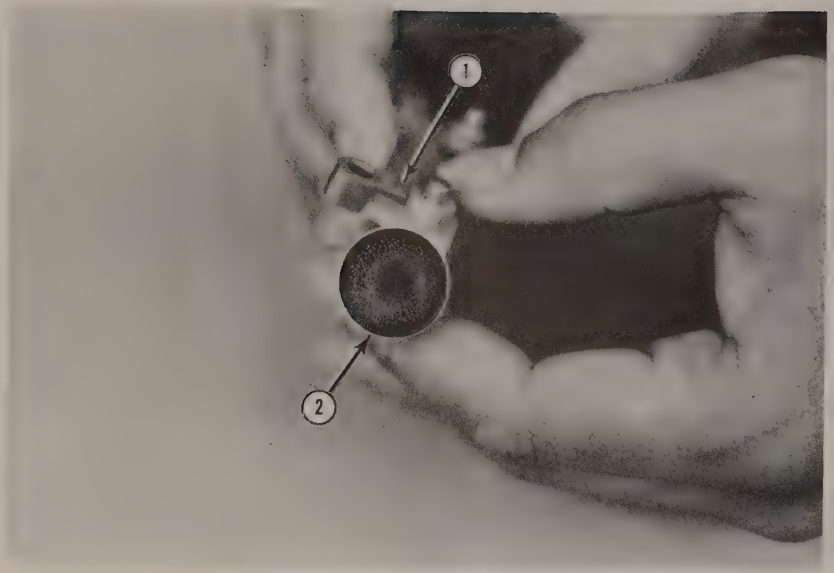
a) Remove the six cover retaining clips (0271-1037), which secure the tub to the casting, and save.

b) Lift optical bench from protective cover and place on workbench.

c) Install the three service legs (0168-9034) to the casting.

3. Optics

a) Inspection and cleansing - Check all optics, mirrors and the monochromator for dirt and damage. Check the small circular mirror on the three way mirror assemby (0271-0158) for a build up of white particulate in a circular pattern. If undetected, breath on that mirror and immediately check for a condensation pattern. If a pattern is predominate, clean that mirror (see Figure 4-6). If any are found dirty or damaged check the following:



1. 3-Way Mirror Assembly *2. U.V. Mirror (small)*

Figure 4-6 - Mirror Location

a) Dirty Mirrors:

1. Blow off all loose particles with clean dry nitrogen.

2. Clean mirrors, using a mild non-abrasive soap, such as orvus, or Ivory liquid dishwashing soap and warm distilled degassed water, by gently floating a soft cotton ball over the surface.

3. Rinse off the detergent completely with distilled water and blow dry with a rapid flow of pure dry nitrogen.

b) Grating

The grating is a replicated surface. Care must be taken when cleaning the grating so as not to deface the surface.

1. If the grating is not cleaned and rinsed properly the grating may get damaged. If the grating is dirty change it.

2. Do not expose mirrors or optics to any solvents. Solvents can destroy the replicated surface, and/or dissolve the bonding epoxy.

c) Dirty Optics

The optics and the phototube can be cleaned with methanol or ethanol and a Q-tip. Blow dry with a rapid flow of nitrogen.

Caution: Keep all solvent away from monochromator and mirrors.

d) Broken, chipped or missing optics and mirrors

1. Do not attempt to rebond any optics or mirrors. These optics and mirrors are bonded and aligned with the use of laser fixtures. Accurate repositioning is extremely difficult without the laser fixture.

2. If any mirrors or optics are found with defects which hinder the normal operation of the instrument, replace the whole assembly that the mirror or optic is bonded to.

4. Mechanical

a) Inspection

Make sure the following are installed or operating properly:

1) Check that the bi-convex lens has the shield (0271-1275). Install properly on the lower plate assembly of the interface. (See Figure 4-7.)

2) Check that the slit assembly (0271-0161) is flush against monochromator and lens is bonded in place. (See Figure 4-7.)

3) Check that the monochromator filter assembly (0271-0167) rides freely on the two pins and are held in place with a spring (0271-1011). (See Figure 4-7).

4) Check that the filter selection is accomplished with little difficulty.

5) If mated to an Autocontrol check that the delrin nut is installed properly. (Refer to instructions 0993-9600.)

6) Check grating arm rides properly on the ramp track. Check that the pin is on ramp and that the arm does not get hung up. (See Figure 4-8).

5. Reinstallation

a) Remove the three service legs.

b) Place the optical bench back into protective cover (0271-1082) and secure it with the six retaining clips that were removed earlier.

c) Place the optical bench, with cover, back into the LC-75 base.

d) Secure the optical bench by replacing the three rubber spacers, washers and screws. Tighten screws.

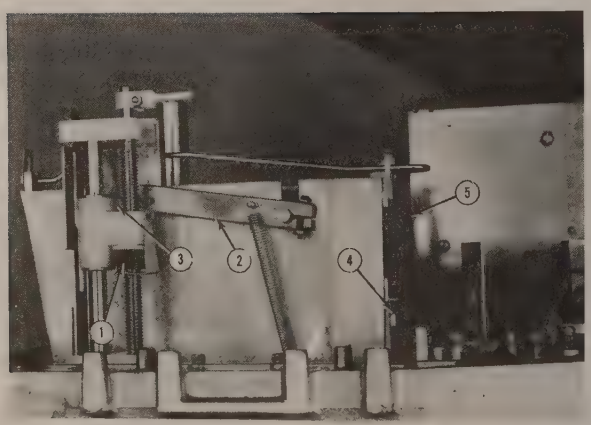
1) Bi-convex Lens Shield Ass'y.

2) Entrance & Exit Slits Ass'y.

3) 3-way Mirror Ass'y.

4) Filter Ass'y.

Figure 4-7 - Bi-Convex Lens and Slit Assemblies



1) Delrin Nut

2) Grating Arm

3) Teflon Block Ramp

4) Entrance & Exit Slits Ass'y.

5) Filter Ass'y.

Figure 4-8 - Grating Arm Location

e) Reconnect the inlet and outlet tubing and secure with two knurled thumb screws.

f) Reconnect the analog board ribbon cable and the stepper motor cable if LC-75 has been mated to the Autocontrol.

g) Reconnect the two connectors P201 and P202 to the casting, and secure with two black pastic cable clamps.

h) Reconnect the D2 lamp supply wires to the D2 lamp terminal board.

i) Replace the air baffle shield. Reroute the cables if LC-75 is mated to an Autocontrol.

4.6 MODIFICATIONS AND UPDATES

4.6A **New Jumpers in Electrometer Board**

The electrometer board has been upgraded with a jumper that disconnects the phototube from the circuit. The purpose of disconnecting the phototube is to isolate the phototube as being the possible cause of drift or noise in the baseline.

4.6B **Nylok Set Screws** (0990-7495)

There are instances where the lamp and flow cell adjustment screws have stripped. These 4 screws should be changed on a "when on site" basis. Repeak the lamp and flow cell after replacing screws.

4.6C **Purge Collar** (0271-0340)

Changes in humidity may cause cyclic drift. A new purge collar has been desigend to correct this problem and should be changed if cyclic drift is observed. See SDB 271-7 for modification procedure.

4.6D **Back Pressure Devices**

Back Pressure devices reduce the noise on baseline caused by the forming of gas bubbles within the flow cell. The two back pressure regulators utilized are the Nupro and the SSI. See Table 4-1.

Table 4-1
Back Pressure Devices

VENDOR	TYPE	BACK PRESSURE	PN
Nupro	fixed	50 psi	0990-3598
		100 psi	0990-3599
SSI	adjustable	0 - 100 psi	0990-7126

Note: These are the only back pressure devices currently recommended for Perkin-Elmer LC flow cells.

The two Nupro regulators are identical in all aspects, except for their pressure rating. The 0990-3598 is rated for 50 psi; the 0990-3599 is rated for 100 psi. They install into the system in the same manner as a tubing union. Table 4-2 helps in selecting the correct back pressure device.

The SSI regulator is the most versatile and is intended to be installed into an LC system with PTFE tubing and is placed into a waste reservoir.

Table 4-2
Detector and Regulator Pressure Rating

Detector	Pressure Rating	Regulator
LC-85	4000 psi	100 psi
LC-75 (later)	4000 psi	100 psi
LC-75 (earlier)	2000 psi	100 psi
LC-65T	2000 psi	100 psi
LC-55	2000 psi	100 psi
LC-25	80 psi	50 psi
LC-15	150 psi	50 psi
LC-10	60 psi	50 psi
RI	80 psi	50 psi
LC-650	150 psi	50 psi
Any two in series		50 psi

4.7 DRIFT/NOISE CHECKS AND FIXES

The LC-75 must be on for 1/2 hour with a clean dry flow cell at 240 nm before performing the following:

> **Note:** D2 lamp and flow cell must be peaked for maximum energy. The energy meter must be as close to zero as possible or in the green region.
>
> The specification for drift is less than 20 divisions in one hour. The specification for noise is ±1 division peak-to-peak.

4.7A LC-75 In tial Checks

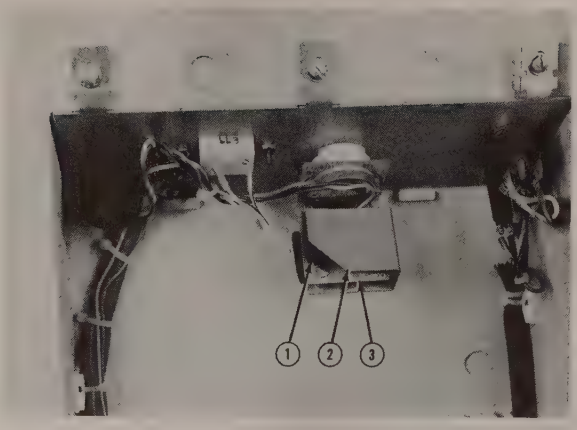
1. Preliminary Checks - If any of the following parts are missing, excessive drift/nosie occurs. Fix if necessary then check drift.

   a) Insulating foam strip (0271-1278) and retaining clip (0271-1279) must be properly installed over the chip of the course zero board (0271-9153). (See Figure 4-9.)

   b) Air baffle shield (0271-1269) must be installed on partition which is between the power supply assembly and the optical/mechanical assembly. (See Figure 4-10.)

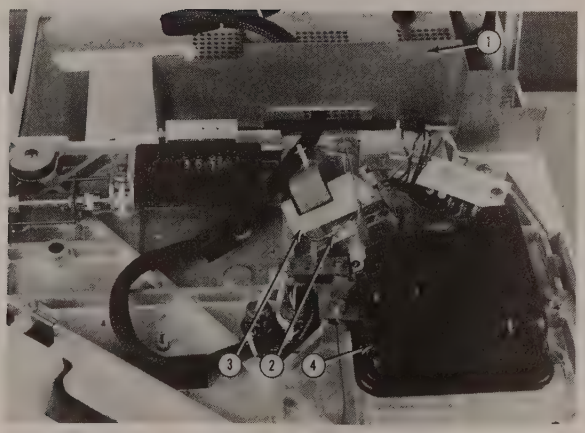
4.7B Engineering Changes Checks

If the above items were installed in the instrument and drift/noise still occurs check the following list of engineering changes that should be incorporated in the LC-75.



1) Insulating Foam Strip
2) Retaining Clip
3) Course Adjust PCB

Figure 4-9 - Insulating Foam Strip and Retaining Clip Location



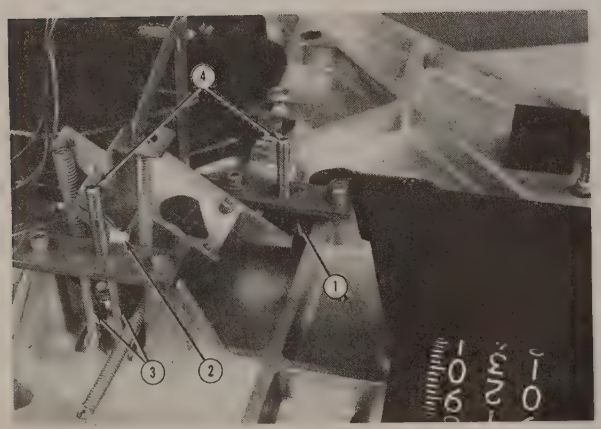
1) Air Baffle Shield
2) D2 Lamp Locking Ass'y.
3) Magnet Bracket Ass'y.
4) Flow Cell Cover

Figure 4-10 - Air Baffle Shield Location

1. The 1/4 inch Delrin balls (0990-0992) which supports the D2 lampholder assembly must be installed in place of the stainless steel balls.

2. There should be two stainless steel plates on the D2 lampholder assembly which are located under the adjustment screws. One plate (0271-1248) is flat and bonded, the other plate (0271-1242) is clipped on the inclined surface of the lamp support (See Figure 4-11.)

3. There are two slider pins (0991-2167) on the D2 lampholder assembly which should not have grooves on them. Change if necessary. (See Figure 4-11.)



1) Stainless Steel Plate

2) Stainless Steel Clip

3) Slider Pins

4) Nylok Adjustment Screws

Figure 4-11 - Slider Pin Location

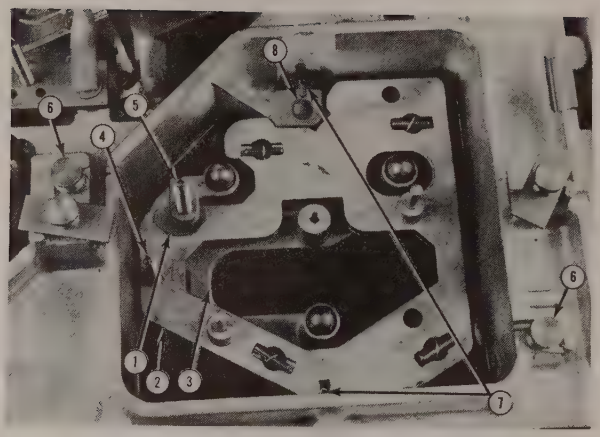
4. There are two stainless steel plates (0271-1338) which are bonded in the flow cell interface. One is bonded to the upper cell plate, the other is bonded to the base casting in the flow cell compartment. (See Figures 4-12 and 4-13.)

5. The inlet and outlet tubing to the flow cell should be replaced with (0271-0283) inlet and (0271-0284) outlet. The new style flow cell has a continuous tube from the inlet to the flow cell itself and flow cell to the outlet. The bulkhead unions are not used any more on the new style flow cell (0271-0338) as of July 1, 1980.

6. The optical base casting (0271-1086) should be silver in color not gold. Gold colored casting may not be heat treated properly.

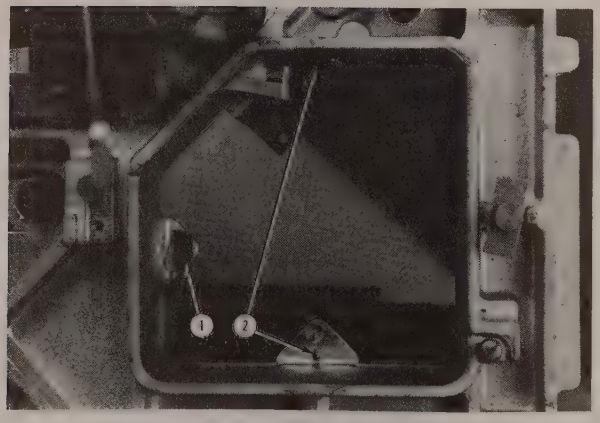
7. The electrometer (0271-9114) should be updated as per section 4.8F,1.

8. Change the D2 lamp and flow cell adjustment screws with new nylok screws (0990-7495).



1) Stainless steel plates
2) Upper cell plate
3) Lower cell plate
4) Front nylok adjustment screw
5) Rear nylok adjustment screw
6) Inlet & outlet thumb screw
7) Locating pins
8) Ball bearing for flow cell plates

Figure 4-12 - Stainless Steel Plate Location



1) Stainless steel plate
2) Guide pins

Figure 4-13 - Cell Compartment Without Interface

4.7C Final Checks

The following should be checked for alignment, cleanliness and proper installation.

1. The D2 lamp window and the ozone trap window should be cleaned as per section 4.8A.3.

2. The D2 lamp should be adjusted for maximum energy peak. See Section 4.8A,6.

3. The flow cell should be adjusted for maximum energy peak after D2 lamp adjustment. See section 4.5B,5.

4. Check if bi-convex lens shield (0271-1275) is properly installed on the bi-convex lens on the lower flow cell plate assembly. (See Figure 4-7.)

5. Inspect all optics refer to section 4.8E.

6. If the smaller 2nm entrance slits (0271-0165) are used in place of the larger 4nm entrance slits (0271-0161) it is important to note that the noise level increases by almost a factor of 2.

4.8 TROUBLESHOOTING

4.8A Drift/Noise Problem Determination Check

If all the items in Section 4.6 have been checked and drift/noise still exist perform the following:

1. To gain access to the electrometer, refer to section 4.8E.

2. Change jumpers SP1 and SP2 on the log. amp. board (0271-9114) from the A-B position to the A-C position and refer to section 4.8E to reinstall the optical bench back into the LC-75. (See Figure 4-14.)

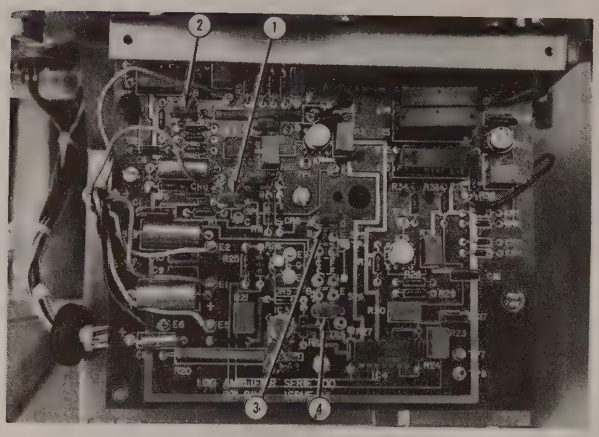
3. Turn on the LC-75 detector adjust course zero to null recorder and check the drift at a wavelength between 50 to 100nm. At this wavelength the phototube is seeing the energy gap between zero order and first order. Therefore no energy strikes the phototube. Proceed as follows if noise or drift -

   a) Still occurs - the detection electronic (course zero potentiometer, electrometer, interface board, and the ^15 volt portion of the D2 lamp driver/power supply board) are at fault and will have to be checked. Refer to section 4.8F.

   b) Has been eleminated - the detection electronics are not at fault. The problem may be any of the following:

      - D2 lamp driver electronics. Refer to section 4.8G,4.
      - D2 lamp (see section 4.8C) change D2 lamp if necessary.
      - Dirty optics. (See section 4.8E.)

- Optics compartment needs nitrogen purge (if drift below 210nm). (See section 4.8B.)
- Dirty flow cell (see SDB 271-3).
- Faulty phototube, change electrometer.



1) SP-1
2) SP-2
3) SP-5
4) SP-6

Figure 4-14 - Log. Amp. Board

4.8B Monochromator Purge

1. If contamination or out gasing is suspected, purge the optics compartment with clean dry nitrogen at a low flow rate (approximately 5 psi) for approximatley 3 hours with the LC-75 power on.

   For proper purging proceed as follows:

   a) Bend an 8 inch piece of prepassivated 043 stainless steel (0087-3035) tubing at 90° approximately 2 inches from one end. (See Figure 4-15.)

   b) Insert the 2 inch portion of the .043 stainless steel tubing into the 1/16 inch I.D. Teflon tubing (0087-3141) which is connected to the nitrogen supply filter assembly. (See Figure 4-16.)

   c) Insert the 6 inch portion of the .043 stainless steel tubing into the monochromator purge inlet.

   d) Start the nitrogen purge.

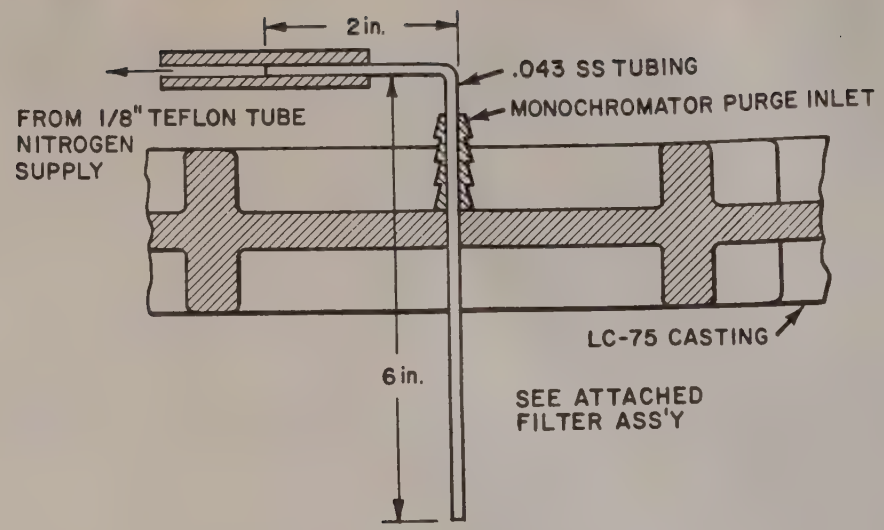


Figure 4-15 - Nitrogen Purge Fitting Crossectional View

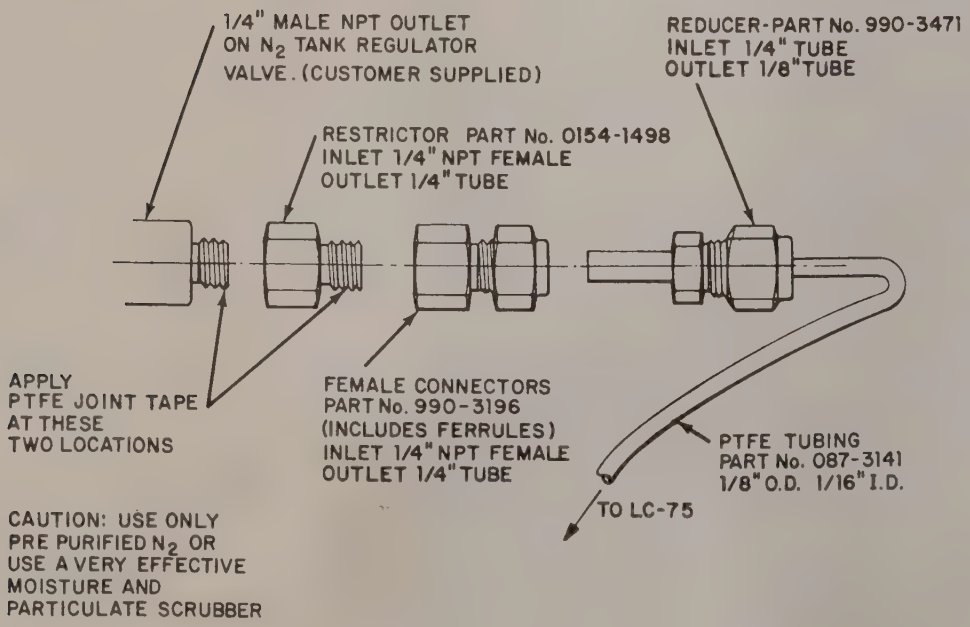


Figure 4-16 - Nitrogen Tank Restrictor and Reducer Adapter

4.8C Deterioration of Deuterium D2 Lamp

Follow the procedures in Section 4.5A.

4.8D Flow Cell Contamination

See Section 4.5B.

4.8E Optical/Mechanical Assembly Contamination

1. Removal of optical bench from the LC-75.

   In order to check and clean optics, the optical bench has to be removed from the instrument as follows:

   a) Remove air baffle shield (0271-1269 if the LC-75 is not mated to an Autocontrol, or 0271-1334 if LC-75 is mated to an Autocontrol.)

   b) Disconnect the power supply D2 lamp wires from the terminal block.

   c) Unsnap the two black plastic cable clamps (0998-4747) and disconnect the two connectors (P201 and P202) from the casting.

   d) If the LC-75 is mated to the Autocontrol, disconnect the benchmark sensor ribbon cable from the analog board. The stepper motor cable has to be unplugged from the Autocontrol and loosened from the LC-75 cover.

   e) Disconnect the inlet and outlet tubing from the flow cell. Disregard if new style flow cell (0271-0338) is used. (See Figure 4-17.)

      1) Loosen the two knurled thumb screws on new instrument or the two socket head screws on older instruments.

      2) Remove the inlet and outlet tubing.

   f) Loosen and remove the three screws (0991-0050), washers (0271-1252) and rubber spacers (0990-8547) which secure the optical bench to the structural foam base of the LC-75 and save.

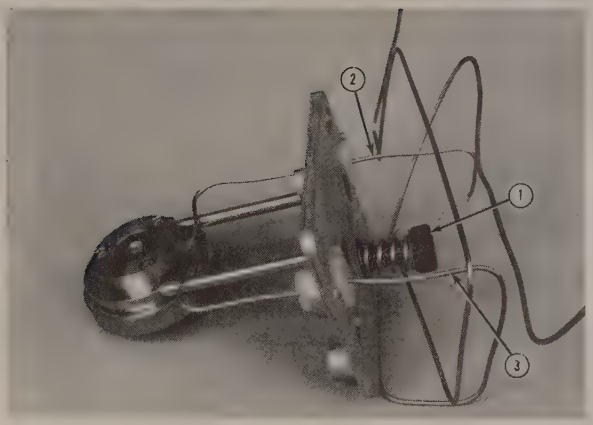
   g) Lift the optical bench from the instrument and place on a table or work bench.

2. Removal of optical bench from protective tub (cover) (0271-1082).

   a) Remove the six cover retaining clips (0271-1037), which secure the tub to the casting, and save.

   b) Lift optical bench from protective cover and place on workbench.

   c) Install the three service legs (0168-9034) to the casting.



1) Securing Thumb Screw

2) Inlet Line

3) Outlet Line

Figure 4-17 - Flow Cell Assembly

3. Optics

a) Inspection and cleansing - check all optics, mirrors and the monochromator for dirt and damage. Check the small circular mirror on the three way mirror assembly (0271-0158) for a build up of white particulate in a circular pattern. If undetected, breath on that mirror and immediately check for a condensation pattern. If a pattern is predominate, clean that mirror. (See Figure 4-18.) If any are found dirty or damaged check the following:

1) Dirty Mirrors

Blow off all loose particles with clean dry nitrogen.

Clean mirrors, using a mild non-abrasive soap, such as orvus, or Ivory liquid dishwashing soap and warm distilled degassed water, by gently floating a soft cotton ball over the surface.

Rinse off the detergent very well with distilled water and blow dry with a rapid flow of pure dry nitrogen.

2) Grating

The grating is replicated surface. Care must be taken when cleaning the grating so as not to deface the surface.

If the grating is not cleaned and rinsed properly, the grating may get damaged. Therefore, the best measure is to change the grating if found dirty. If necessary to clean do step 4.8,3a.

Do not expose mirrors or optics to any solvents. Solvents can destroy the replicated surface, and/or dissolve the bonding epoxy.

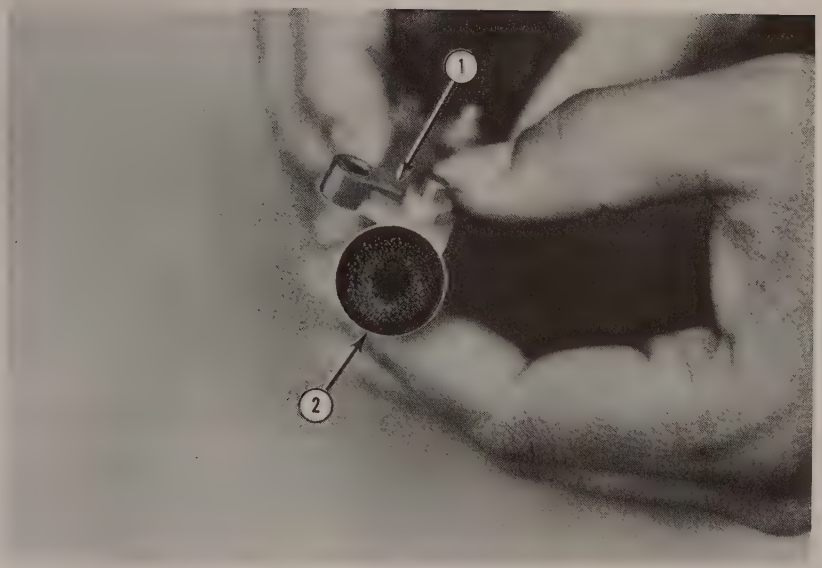


Figure 4-18 - 3-Way Mirror Assembly

3) Dirty optics - The optics and the phototube can be cleaned with methanol or ethanol and a Q-tip. Blow dry with a rapid flow of nitrogen.

Caution: Keep all solvents away from monochromator and mirrors.

4) Broken, chipped or missing optics and mirrors -

Do not attempt to rebond any optics or mirrors. These optics and mirrors are bonded and aligned with the use of laser fixtures. Accurate repositioning is extremely difficult without the laser fixture.

If any mirrors or optics are found with defects which hinder the normal operation of the instrument, replace the whole assembly which the mirror or optic is bonded to.

4. Mechancial

a) Inspection - Make sure the following are installed or operating properly.

1) Check the bi-convex lens has the shield (0271-1275) installed properly on the lower plate assembly of the interface. (See Figure 4-7.)

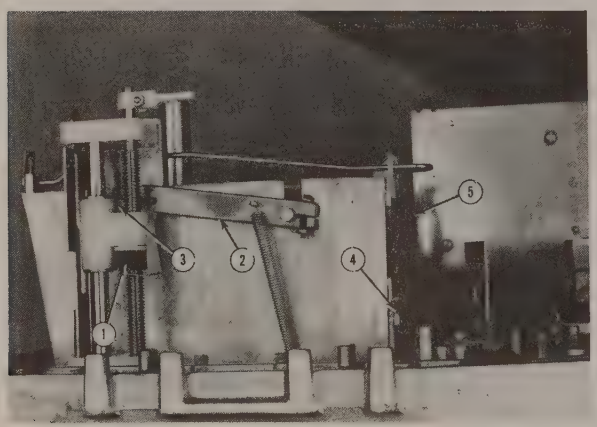
2) Check that the slit assembly (0271-0161) is flush against monochromator and lens is bonded in place. (See Figure 4-7.)

3) Check the monochromator filter assembly (0271-0167) rides freely on the two pins and are held in place with a spring (0271-1011). (See Figure 4-7.)

4) Check that filter selection is accomplished with little difficulty.

5) If mated to an Autocontrol check the delrin nut is installed properly. (Refer to instructions 0993-9600.)

6) Check that the grating arm rides properly on the ramp track. Check that the pin is on ramp and that the arm does not get hung up. (See Figure 4-19.)



1) Delrin Nut

2) Grating Arm

3) Teflon Block Ramp

4) Entrance & Exit Slits Ass'y.

5) Filter Ass'y.

Figure 4-19 - Grating Arm and Ramp Track Location

5. Reinstallation

a) Remove the three service legs.

b) Place the optical bench back into protective cover (0271-1082) and secure protective cover with the six retaining clips that were removed earlier.

c) Place the optical bench with cover back into the LC-75 base.

d) Secure the optical bench by replacing the three rubber spacers, washers and screws. Tighten screws.

e) Reconnect the inlet and outlet tubing and secure with two knurled thumb screws.

f) Reconnect the analog board ribbon cable and the stepper motor cable if LC-75 has been mated to Autocontrol.

g) Reconnect the two connectors P201 and P202 to the casting, and secure with two black plastic cable clamps.

h) Reconnect the D2 lamp supply wires to the D2 lamp terminal board.

i) Replace the air baffle shield. Reroute the cables if LC-75 is mated to an Autocontrol.

4.8F Electronics

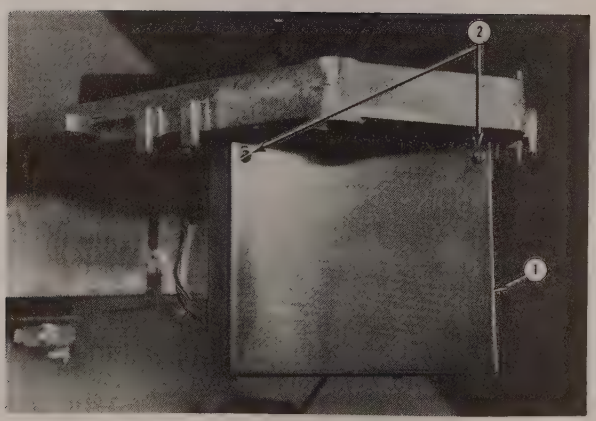
After determining noise and drift is caused by electronic portion of LC-75 proceed as follows:

1. Preliminary Check:

a) Electrometer modification check. With LC-75 power off remove the optical bench from LC-75 and manipulate the optical bench so that the log amp. board is easily accessible. See Section 4.8E, 1 and 2.

Note: Handle log amp. board by the edges only.

1) Remove two 6/32 x 5/16 inch binding head screws securing the electrometer cover. (See Figure 4-20.)



1) Electrometer Cover

2) Electrometer Cover Screws

Figure 4-20 - Electrometer Cover

2) Check for old log amp. board configuration. C1-100 uf, R1-160 K ohms, R40-1 meg. ohm. (See Figure 4-21.)

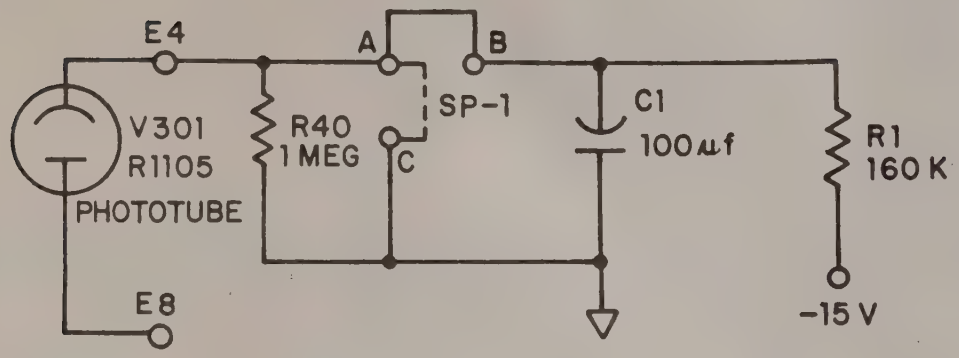


Figure 4-21 - Old Style Log Amp. Circuit Configuration

3) If old style log amp. board is found, continue on. If new style log amp. board is found proceed to section 4.8F, 4a.

2. Old style Log Amp. Board Upgrade

a) Remove C1, R1 and R40.

b) In place of R1 install a 365 ohm resistor (0995-8750).

c) In place of R40, install a 2.2 uf capacitor (0996-2568).

d) In place of C1, install two piggyback sensor diodes 1N825A (0997-2881). (See Figure 4-22.)

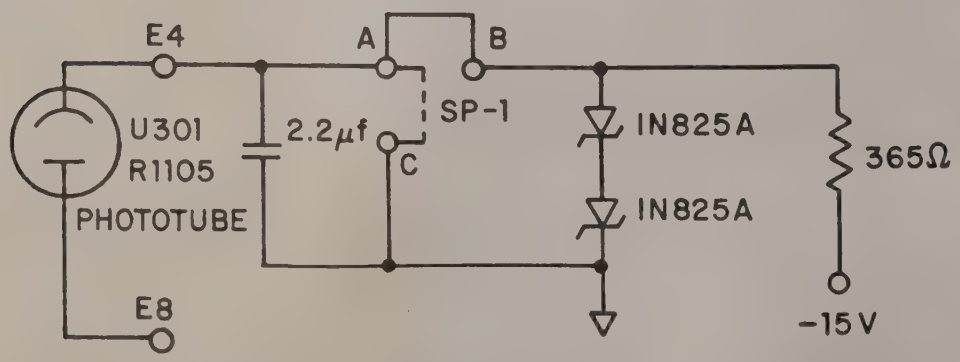


Figure 4-22 - New Style Log. Amp. Circuit Configuration

3. Log Amp. Board Cleansing

   a) Clean all solder connections whether or not modification above was performed with methanol or freon.

   b) Clean R9, R20, Q1, E8, E4 and any portion of the board that may have been accidentally touched with methanol or freon.

4. Elimination of log amp., interface and attenuator as problem. Before proceeding, make sure power supply voltages are stable. (See Section 4.4.)

   a) Log Amp. Board Setup (0271-9114)

      1) Disconnect P201, P202 and the D2 lamp from LC-75 casting. If mated to an Autocontrol, disconnect the stepper motor and the 10 conductor ribbon cable from J6 of the analog board.

      2) Change jumpers SP5 and SP6 on the log. amp. board (0271-9112) from the AD position to the BE position. (See Figure 4-23.)

      3) Connect a dummy cable in place of P202, this is one of the two connectors that go to the electrometer and has only one cable in it, to the electrometer. (See Figure 4-23 for dummy cable.) Also, reconnect P201.

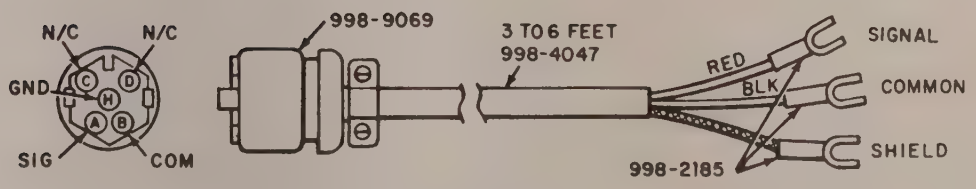


Figure 4-23 - Dummy Cable

      4) Place the casting back into the LC-75. It is not necesary to place the casting back into protective tub at this time.

      5) Connect the lugs of the dummy cable to channel A of a 10mv dual pen recorder. If a dual pen recorder is unobtainable, use two recorders with the same range and chart speed.

      6) Adjust wavelength between 50 to 100nm.

5. Interface Board Setup (0271-9074)

   a) Place a recorder cable (0254-0943) between the 10v output terminals of the interface board and channel B of the 10mv dual pen recorder.

   b) Short pins 2 and 7 of J501 on the interface board, or TP2 and TP8 on the analog board (0271-9103) if mated to an Autocontrol.

   c) Disconnect J4 (a 14 pin ribbon connector) from the interface board or analog board.

   d) Turn LC-75 power on.

   e) Set the Fine Zero for an approximate zero at channel B of the dual pen recorder. If LC-75 is mated to Autocontrol places SP1 in Autocontrol and SP2 in AB of the analog board, then adjust the fine zero as above.

6. After instrument warms up for 30 minutes, check for drift/noise at both channels.

   a) If channel A is noisy or drifts but not B, then the final stages of the log amp. is at fault. Proceed to Section 4.8G,1.

   b) If channel B is noisy or drifts, but not A then the interface or analog board is at fault, proceed to Section 4.8G,2.

   c) If both channels are noisy or drifty, then the power supplies (see Section 4.8G,3) or both log amp. and interface and analog board are at fault.

   d) If neither channel drifts, then the problem may lie in one of the following:

      The front end of the log amp. board (see Section 4.8G,1a).

      The attenuator switch board (see Section 4.8G,2).

      If mated to an Autocontrol, the correction circuits of the analog board. (See Section 4.8G,2.)

4.8G Electrometer, Noise and Drift Problems

1. Fault with electrometer - After determining electrometer is at fault, you can either change electrometer (see Section 4.8G,2) or proceed to troubleshooting. See Table 4-2.

   a) Log amp. board front end - If the front end is the cause of the problem, replace the whole log amp. board assembly including cover.

   b) Log amp. board final stages - If the rear end of the log amp. board is the cause of the problem, then either IC4, IC5, IC6 or their associated components are at fault. Change components accordingly and clean board as per Section 4.8F,3.

c) If any component above were changed the instrumentation amp. and bessel filter has to be readjusted as follows:

1) Set jumpers as follows: (See Figure 4-14.)

SP-4	B-C
SP-5	B-E
SP-6	B-E

2) Connect DVM to TP7 (-) and TP8 (+), adjust R23 for zero (±0.03mv).

3) Connect DVM to TP6 (+) and TP2 (-), adjust R32 for zero (±0.03mv).

4) Connect DVM between E12 (+) and TP2 (-), adjust R32 for zero (±0.1mv).

5) Move jumper SP5 and SP6 to the C-F position, adjust R30 for zero (±0.01mv) at E12 (+) to TP2 (-).

6) Return jumpers to normal configuration as follows:

SP-1	A-B
SP-2	A-B
SP-3	A-B
SP-4	A-B
SP-5	A-D
SP-6	A-D

7) Replace electrometer cover and secure with two 6/32 x 5/16 inch binding head screws which were removed earlier.

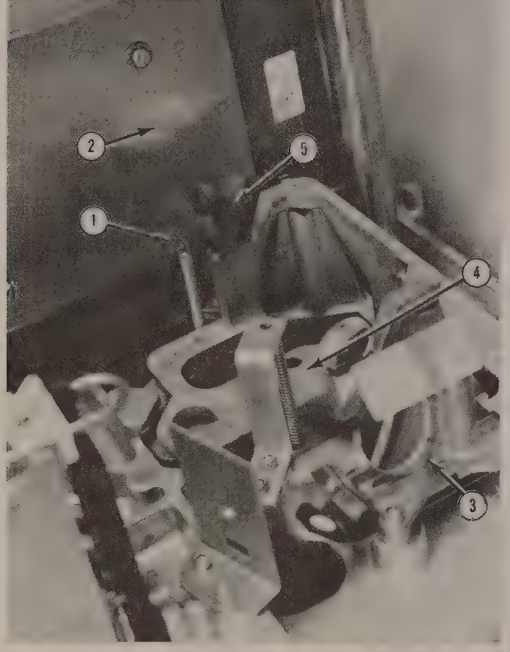
8) Replace the optical bench into the LC-75 box (refer to Section 4.8E,5) reconnect all harness and jacks.

2. Electrometer Replacement

a) Remove the optical bench from the LC-75. See Section 4.8E,1 and 2.

b) Removal from casting

1) Remove the spring (0990-2308) which secures the flow cell lens assembly to the casting and is attached to a spade bolt on the electrometer housing. (See Figure 4-24.)



1) Spade Bolt

2) Electrometer Ass'y.

3) 3-way Mirror Ass'y.

4) Flow Cell Interface

5) Bi-convex Lens Shield

Figure 4-24 - Flow Cell Lens and Electrometer Assembly

2) Remove three 6/32 x 1/4 inch socket head screws securing electrometer's harness connector.

3) Remove two 8/32 x 1/4 inch socket head screws securing the electrometer to the casting and gently lower the electrometer from casting.

c) Reinstallation of electrometer - Reverse the steps of electrometer removal.

3. Interface or Analog Board Problem

a) Interface board (0271-9074) IC1 and its associated components may be causing the problem. Change faulty components or change entire board.

b) Analog board (0271-9130) - If the signal circuit (IC1, IC2 and associated components) were found good (Section 4.8F,6) set SP1 to AB and SP2 to AB. Check for drift or noise.

1) If drift or noise is present then problem is in the D.A.C. correction circuits, (IC4, IC5, IC3, IC7 and associated components). Change as required.

2) If no noise or drift is present, then the attenuator switch board (0271-9143) is at fault. Change attenuator switch board.

4. Power Supply/D2 Lamp Driver Voltage Checks (0271-9120)

   a) Check ±15 Vdc for correct levels and stability.

   b) Check the voltage across R9, between TP4 (+) and TP8 (-) with a multirange recorder.

      1) After a 30 minute warm-up, adjust R12, if necessary for .500± .02V.

      2) Monitor the voltage across R9 (D2 lamp current sensor) for drift or noise.

      3) Check that the voltage across R9 does not fluctuate more than ±1.1112 volts. If it does, then the D2 lamp current circuit (CR2 and CR3, IC2, Q3, Q101, D2 lamp and their associated components) are at fault, change as required.

   c) D2 lamp voltages

      1) Check the D2 lamp filament voltage between the two blue leads.

         Voltage with D2 lamp unlit, approximately 12.5 Vac.

         Voltage with D2 lamp lit, approximatley 7.5 Vac.

      2) Check the D2 lamp anode voltage between the red lead (+) TP8 (-) or ground.

         Voltage before K1 relay energizes is approximately 120 Vdc.

         Voltage after K1 relay energizes increases to 600 Vdc then quickly drops to approximately 80 Vdc and stabilizes.

Table 4-2
Troubleshooting Chart

OBSERVATION	PROBABLE CAUSE
No power to detector	1. Fuse F101 is blown. 2. High voltage fuse F102 is blown. 3. Low voltage power supply board is faulty.
Deuterium lamp does not light.	1. Deuterium lamp wires are loose. 2. Deuterium lamp is faulty.
No detector response.	1. Deuterium lamp is out of poisiton. 2. Foreign object in the sample compartment. 3. Cell assembly is out of position. 4. Wavelength setting is below cutoff wavelength of the solvent.
Low response and 0A cannot be set.	1. Lamp mirror is slightly out of position. 2. Foreign object in the sample compartment. 3. Deuterium lamp is badly darkened. 4. Sample compartment quartz windows are dirty. 5. Signal amplifiers may required service.
Detector response is unsteady regardless of the position of the controls.	
1. Deuterium lamp flickers.	1a. Deuterium lamp wire connections are loose. 1b. Deuterium lamp is faulty.
2. Deuterium lamp is properly lit and aligned properly.	2a. Solvent is interferring with detector response. 2b. Cell holder is loose. 2c. Excessive line voltage fluctuation. 2d. Sample is unstable.
Indications are incorrect	
1. Successive indications on on the same material are not reproducible.	1. False chemical standard.
2. Indications do not agree	2a. Change in chemicals or technique from previous with previous determinations run. 2b. Laboratory enviornment contains UV-absorbing vapors.
3. Calibration is off.	3. Wavelength calibration is off.

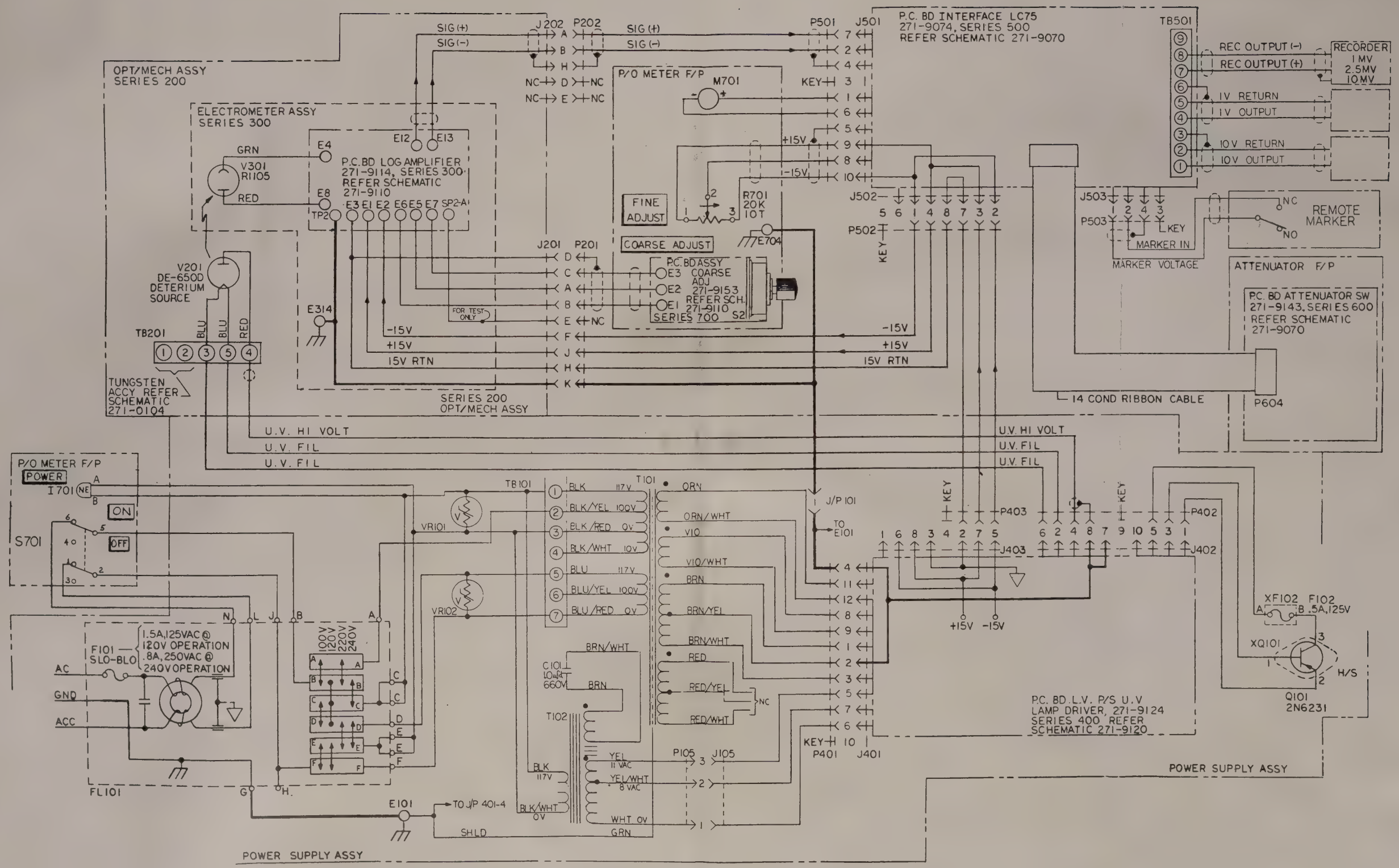
UV lamp does not light	1. Poor connection at TB201. 2. Defective lamp 3. Defective power supply board (0271-9124)
Cannot zero recorder, but can zero energy meter	1. Defective recorder cables 2. Improper hookup 3. Defective interface board
Instrument fails noise specifications	1. Optics dirty 2. Optics defective 3. Lamp defective 4. Flow cell need rebuilding 5. Electronics defective (0271-9114)
Energy meter on panel does not zero	1. Power suppy voltages incorrect 2. Electrometer defective (0271-9114) 3. Coarse Adjust Assembly defective (0271-9153) 4. Interface PC Board defective (0271-9074) 5. Bad panel meter.

5 SCHEMATICS

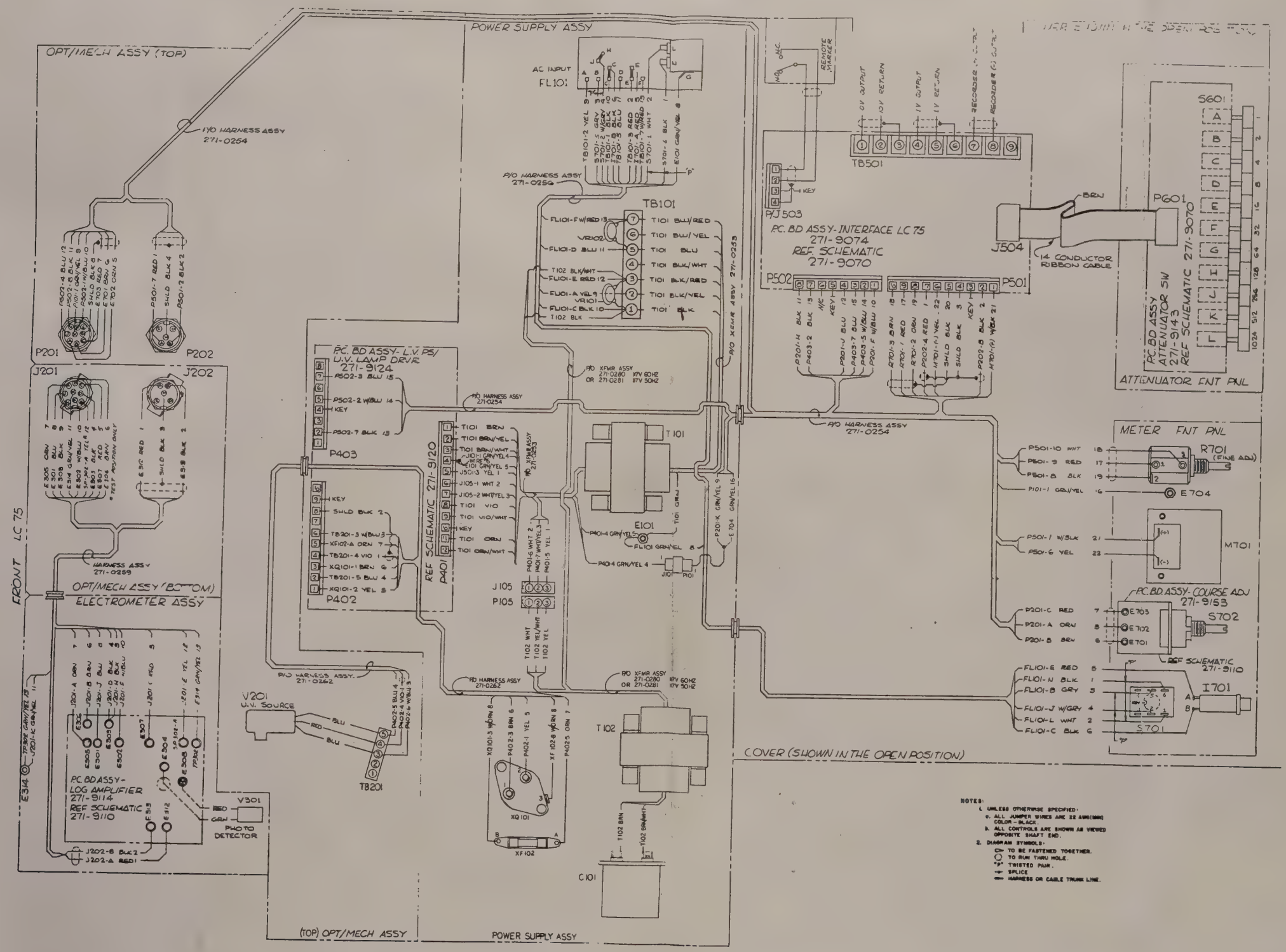
5 SCHEMATICS

5.1 DESCRIPTION

This section is a compilation of schematics required to support circuit descriptions and assist in troubleshooting the LC-75.

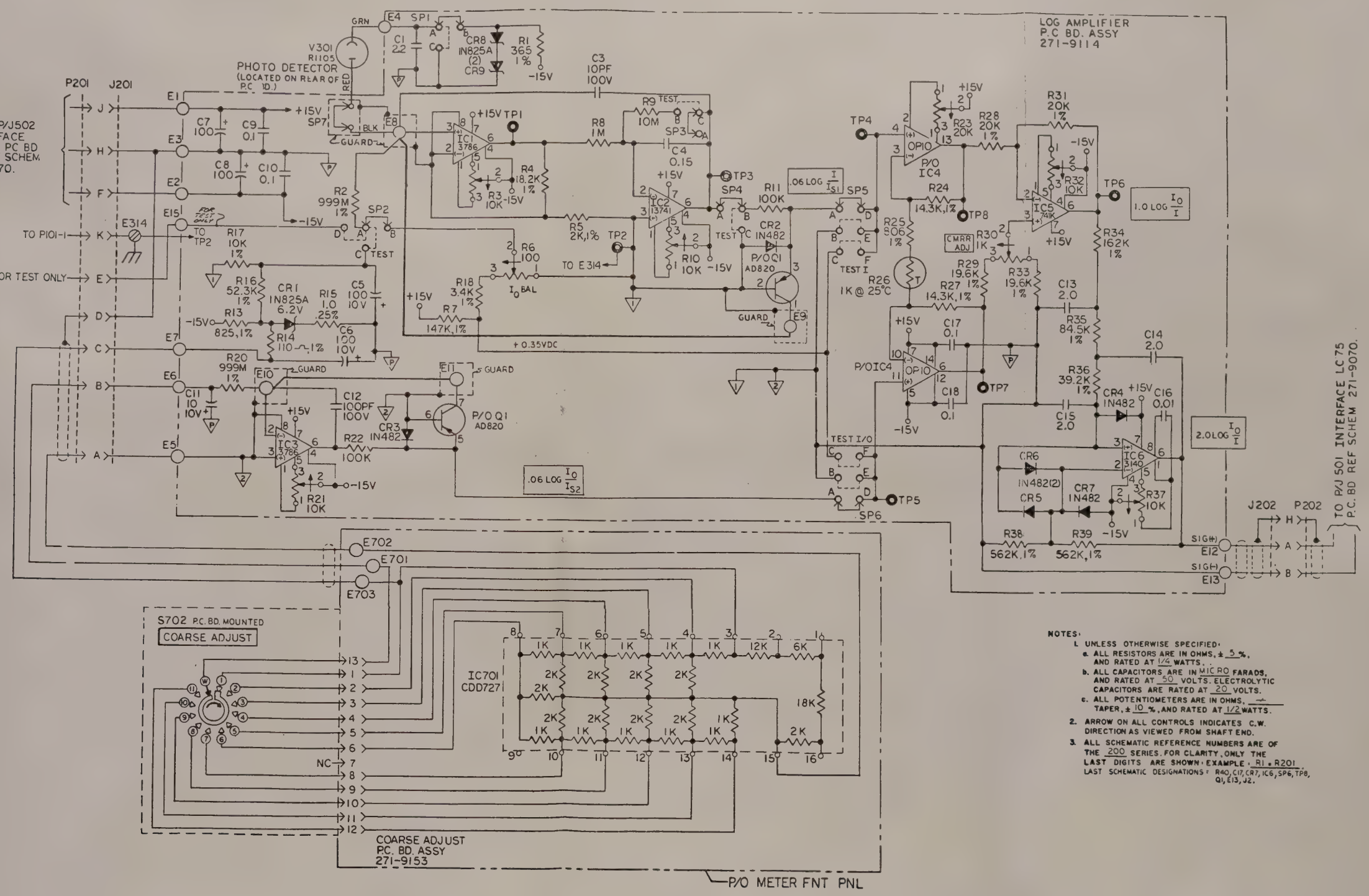


Interconnection Diagram
0271-0102



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL JUMPER WIRES ARE 22 AWG(MIN) COLOR - BLACK.
   b. ALL CONTROLS ARE SHOWN AS VIEWED OPPOSITE SHAFT END.
2. DIAGRAM SYMBOLS:
   ⊏⊐ TO BE FASTENED TOGETHER.
   ○ TO RUN THRU HOLE.
   "P" TWISTED PAIR.
   ⊸ SPLICE
   ═ HARNESS OR CABLE TRUNK LINE.

Wiring Diagram
0271-0103

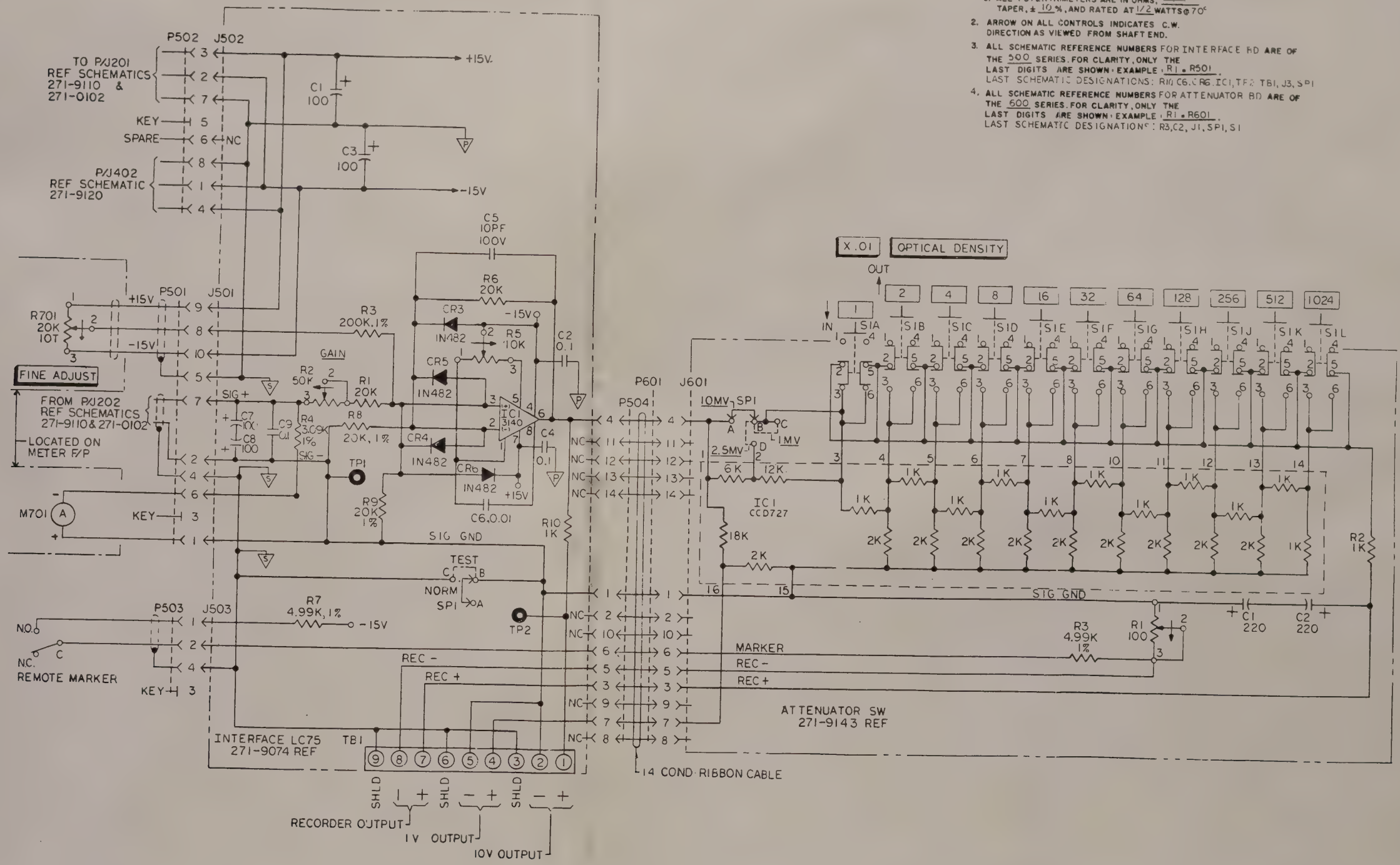


NOTES:

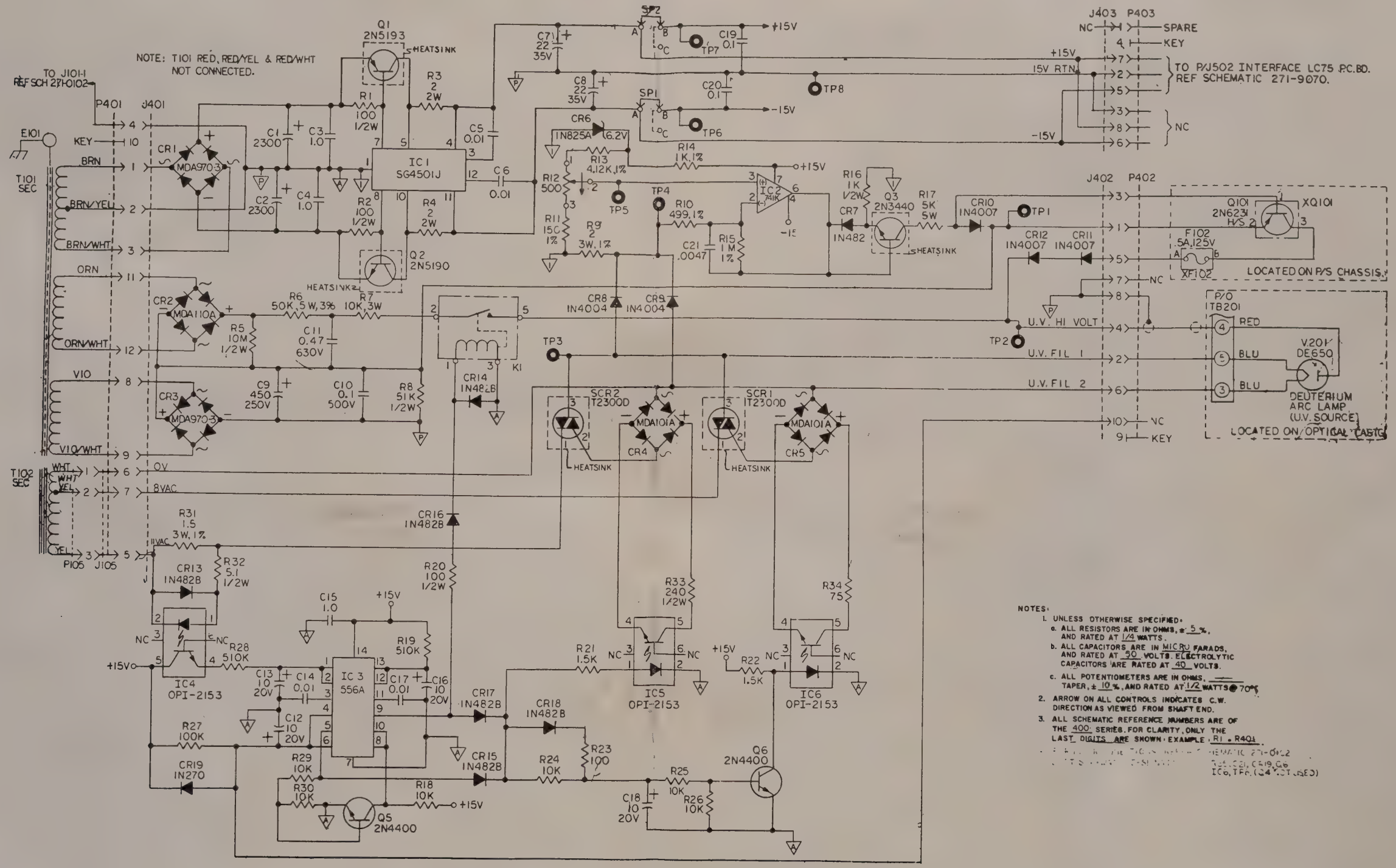
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, — TAPER, ± 10 %, AND RATED AT 1/2 WATTS.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 200 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R201
   LAST SCHEMATIC DESIGNATIONS: R40, C17, CR7, IC6, SP6, TP8, Q1, E13, J2.

Amplifier Schematic
0271-9110

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ____ TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°C
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS FOR INTERFACE BD ARE OF THE 500 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R501
   LAST SCHEMATIC DESIGNATIONS: R10, C6, CR6, IC1, TP2, TB1, J3, SP1
4. ALL SCHEMATIC REFERENCE NUMBERS FOR ATTENUATOR BD ARE OF THE 600 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R601
   LAST SCHEMATIC DESIGNATIONS: R3, C2, J1, SP1, S1



Interface Schematic
0271-9070



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 40 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ___ TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°C
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 400 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R401.

[illegible] SCHEMATIC 271-0102
[illegible] C419, C6
IC6, TP6, (24 NOT USED)

Power Supply/Driver Schematic
0271-9120

APPENDIX 1

SERVICE DATA BULLETINS

PERKIN-ELMER

Instrument
Sales and Service Division
Main Avenue
Norwalk, Connecticut 06856

SERVICE DATA BULLETIN

NO: 271-7

SUBJECT: LC-PURGE COLLAR & OZONE TRAP MODIFICATION

PREPARED BY: TRAINING AND ENGINEERING DEPARTMENT PAGE 1 OF 4 PAGES

DISTRIBUTION: [x] DOMESTIC [x] INTERNATIONAL [x] DEALERS DATE: 3-3-81

PROBLEM:

Changes in humidity may cause drift in the LC-75 Detector.

PURPOSE:

To provide the Field Service Engineer with an engineering change which upgrades the lamp assembly, thereby, correcting the drift problem caused by humidity changes.

MATERIALS REQUIRED:

1. Appropriate Handtools
2. Purge Collar (new style - 0271-0340)
3. S.D.B. 271-2

PROCEDURE:

Determine if the instrument has an old or new style purge collar. (See Fig. 1.) Perform the following procedure when required.

To change purge collar to the new style, turn the instrument power off and proceed as follows:

1. Remove the D_2 lamp, the teflon seal, and the magnet assembly from the lamp holder assembly and set them aside. See S.D.B. 271-2, Section V-A-1 & 2.
2. Remove the lamp holder assembly from the casting as follows: (See fig. 2)
   a. Remove the horizontal and vertical springs for the lamp holder assembly. Save the springs.
   b. Remove the lamp holder assembly by twisting it in a clockwise direction while lifting up. Save the 0.375 diameter stainless steel ball that falls from the holder.
   c. Knockout and discard the quartz window that is bonded to the lamp holder assembly. (See fig. 3)

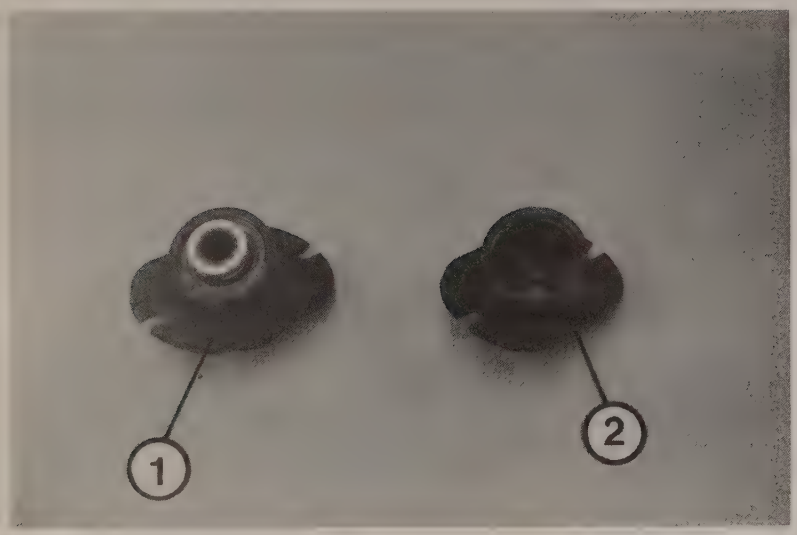


Figure 1

1. Old Purge Collar
2. New Purge Collar

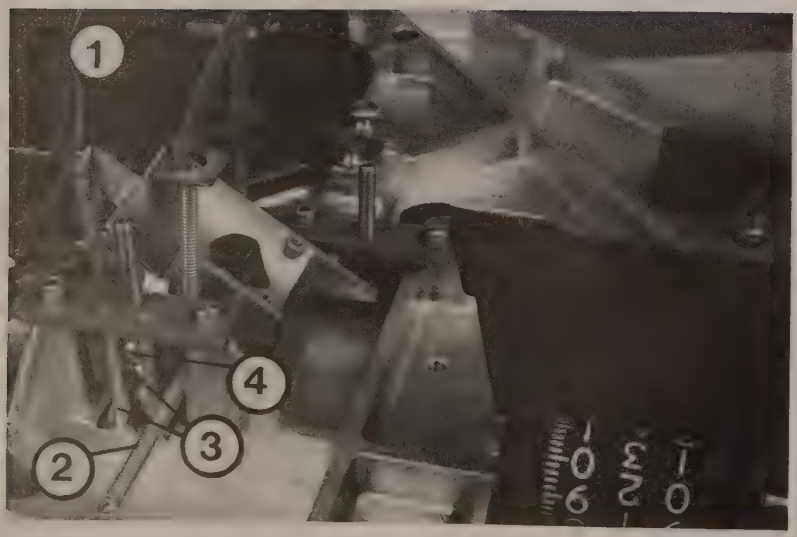


Figure 2

1. D_2 Lamp Vertical Spring
2. D_2 Lamp Horizontal Spring
3. Slider Pins
4. Stainless Steel Ball (.375)

3. Remove and save the spade bolt (0990-4440) and the 6-32 x ¼ inch soc. hd. screw that secures the old style purge collar to the LC-75 casting.
Note the position of the old collar on the casting. (See Fig. 4)

4. Remove the old style purge collar.

5. Position the new style purge collar on the casting in place of the old style collar, as was noted earlier. (See Fig. 4)

6. Secure the new style purge collar with the spade bolt and the 6-32 x ¼ inch soc. hd. screw. (See Fig. 4)

7. Clean the quartz window in the purge collar with acetone and a "Q"-tip.

8. Position the lamp holder assembly back on the casting.

9. Replace the horizontal and vertical springs on the lamp holder assembly.

10. Replace the 0.375 diameter stainless steel (see fig. 2) ball so that it:

    a. Sits on the inclined surface of the lamp holder assy. (See Fig. 3)

    b. Is resting against the two slider pins, and

    c. Is beneath the rear adjusting screw.

11. For reinstallation of the D_2 lamp refer to SDB 271-2, Section V-A-3, Section V-B, and Section V-c

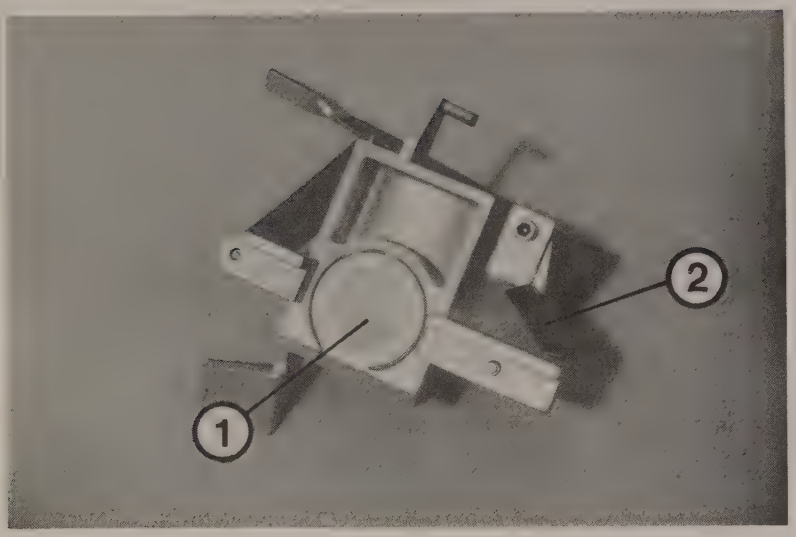


Figure 3

1. Quartz Window
2. Inclined Surface with stainless steel clip on.

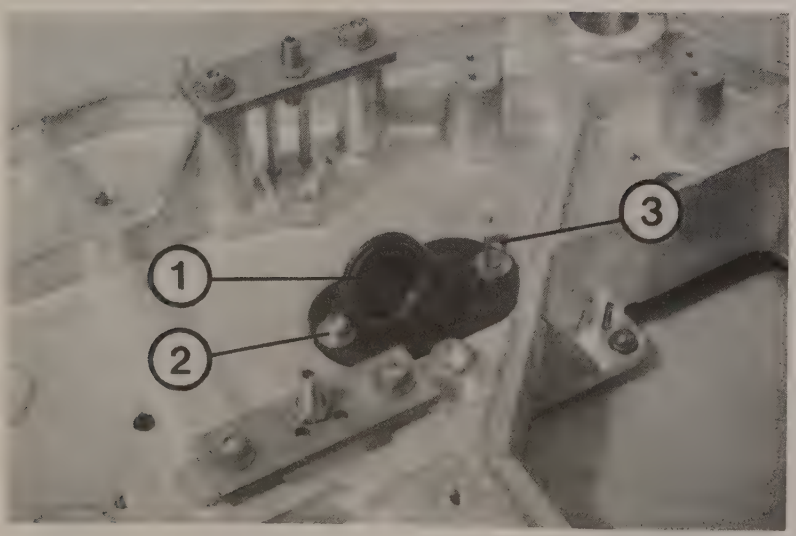


Figure 4

1. New Purge Collar
2. 6-32 x ¼ inch soc. hd. screw
3. Spade Bolt

PERKIN-ELMER

Instrument
Sales and Service Division
Main Avenue
Norwalk, Connecticut 06856

SERVICE DATA BULLETIN

NO: 271-17

SUBJECT: FILTER SELECT P.C.B. ALIGNMENT

PREPARED BY: TRAINING AND ENGINEERING DEPARTMENT PAGE 1 OF 6 PAGES

DISTRIBUTION: [x] DOMESTIC [x] INTERNATIONAL [x] DEALERS DATE: Sept. 1, 1981

PROBLEM:

There is a difference in static baseline offset between the slow, medium, and fast filter positions on the LC-85.

PURPOSE:

This bulletin will provide the FSE with the p/n's and procedures necessary to change the gain and loading of the Slow and Fast filter circuits.

MATERIALS REQUIRED:

Item	Quantity	Nomenclature	Part Number
1	1	1.50 MΩ Resistor (R11)	0995-9097
2	1	249 KΩ Resistor (R21)	0995-9022
3	1	499 KΩ Resistor (R24)	0995-9051
4	2	20Ω Resistor (R31 & 32)	0995-1291
5	1	Soldering Iron - 25 watt	N/A
6	A/R	Solder	N/A
7	A/R	Hand Tools	N/A
8	A/R	Methanol, Ethanol or Freon	N/A
9	1	DVM, 3½ digit	N/A
10	A/R	SDB 271-18	N/A

GENERAL:

1. This procedure is to be performed on a "when on site basis."
2. All instruments shipped after October 1, 1981, will have this problem corrected at the factory.
3. Exercise caution when handling the Filter Select P.C.B. There are MOS devices on this circuit board.
4. Exercise caution when removing or replacing the screws that hold the sheet metal cover. If they are dropped, they may fall into the power supply.
5. As of the date on this bulletin, the Filter Select P.C.B. schematic is not included in the user's manual. It is included as Fig. 3 of this S.D.B. This schematic does not reflect the changes described in this bulletin.

PROCEDURE:

1. Make certain that the LC-85 power is off and the instrument is unplugged from AC power.

2. Locate the Filter Select P.C.B. It is located inside the instrument top cover on the right hand side. (See Fig. 1)

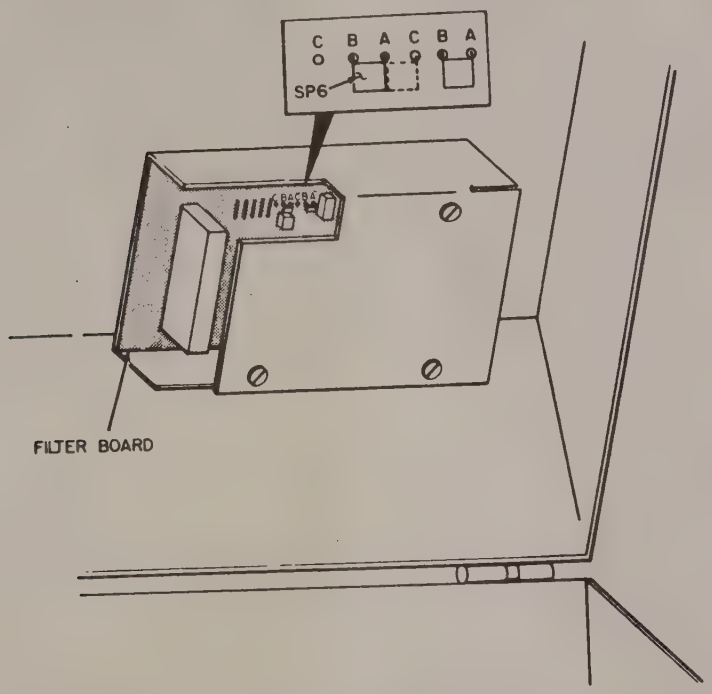


Figure 1 - Jumper SP6 and the Filter Board

3. Remove the sheet metal cover. Removal is easier if the right hand screws are removed first.

4. Remove the P.C.B.

5. Locate R11, a 1.69 MΩ resistor, and remove from the board. (See Fig. 2)

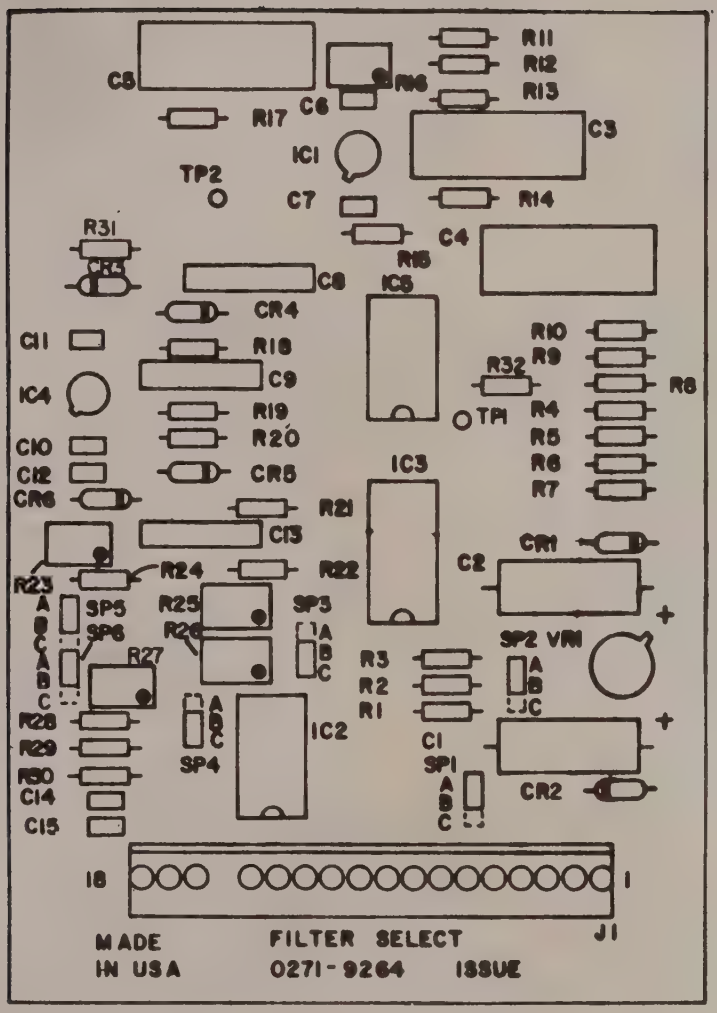
6. Replace R11 with a 1.5 MΩ resistor (P/N 0995-9097).

7. Locate R21, a 267 KΩ resistor, and remove it from the board. (See Fig. 2)

8. Replace R21 with a 249 KΩ (P/N 0995-9022).

9. Locate R24, a 511 KΩ resistor, and remove it from the board. (See Fig. 2)

Figure 2



10. Replace R24 with a 499 KΩ (P/N 0995-9051).

11. Locate and remove R31 and R32. These are 200 Ω resistors. (See Fig. 2)

12. Replace R31 and R32 with 20 Ω resistors (P/N 0995-1291).

13. Save the excess lead trimmed from one of the resistors.

14. Clean all flux deposits off the components and the P.C.B. with ethanol, methanol or freon.

15. Reinstall the P.C.B. into the instrument. Do not reinstall the sheet metal cover at this time.

16. Reconnect the AC to the LC-85 detector.

17. Make the following initial settings:

    a. Power : ON
    b. Filter Select: Medium
    c. Wavelength : 240
    d. Attenuator : X8
    e. D_2 lamp : peaked as per SDB 271-18
    f. Flow Cell : peaked as per SDB 271-18

18. R27 Adjust

    a. Remove SP5 and SP6.
    b. Connect the DVM positive lead to pin A of SP5 and negative lead to pin C of SP1 (ground).
    c. Adjust R27 for 0.000 volts DC $\pm$ 0.002; this is usually the fully counter clockwise direction.
    d. Install SP5 and SP6 to their AB positions.

19. Fast Filter Offset Adjust

    a. Set Filter Select to Fast.
    b. Place SP4 to the AB position.
    c. Connect DVM positive lead to TP2.
    d. Adjust R23 for 0.000 volts DC $\pm$ 0.001.
    e. Return SP4 to the BC position.

20. Slow Filter Offset Adjust

    a. Set Filter Select to Slow.
    b. Place SP3 to the AB position.
    c. Connect DVM positive lead to TP1.
    d. Adjust R16 for 0.000 volts DC $\pm$ 0.001.
       Note: Because of the very slow response of the slow filter, allow at least twenty seconds of settling time before regarding the DVM reading as valid.
    e. Return SP3 to the BC position.

21. Remove the cell cover.

22. Turn both the adjusting screws counter clockwise exactly five full turns. Counting the turns will make the cell much easier to re-peak. Replace the cell cover.

23. Place SP6 to the BC position.

24. Take the piece of resistor lead that was saved in Step 13 and insert it into pin 10 of P801. Measure the voltage by connecting the positive lead of the DVM to the lead in pin 10. Record the voltage. The reading should be approximately 0.800 volts DC.

25. Place the Filter Select switch to the Slow position. Adjust R26 so that the voltage is the same as that recorded in Step 24. Note: Because of the very slow response of the slow filter, allow at least twenty seconds of settling time before regarding the DVM reading as valid.

27. Remove the resistor lead from pin 10. Disconnect the DVM.

28. Reinstall the sheet metal cover.

29. Remove the cell cover.

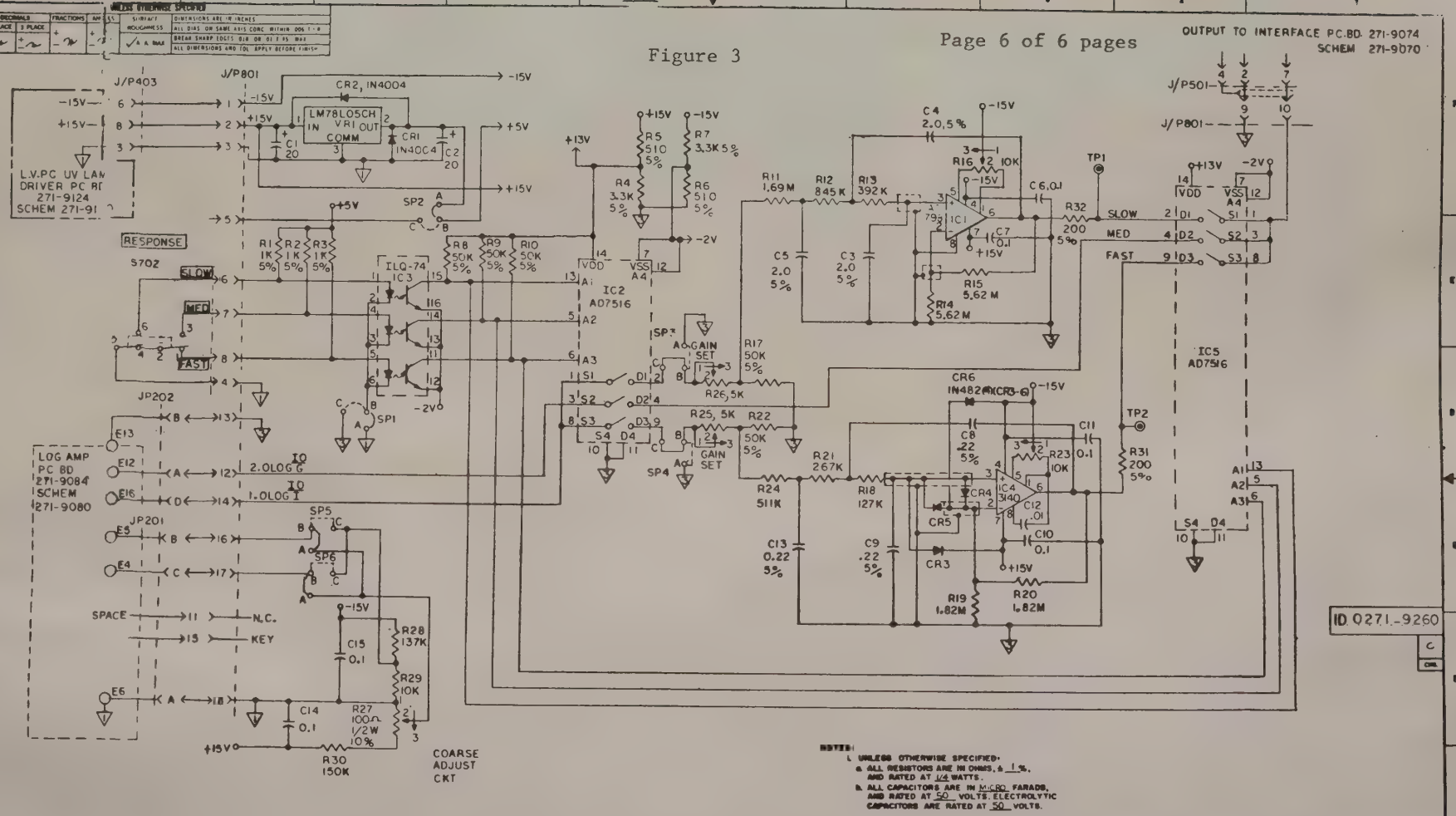
30. Turn the cell adjusting screws exactly five full turns clockwise.

31. Finish repeaking the cell as per SDB 271-18.

32. Reinstall the cell cover.

33. Check for less than 4 recorder divisions of baseline shift on X1 when changing filter positions. If there are gross differences, either an error in procedure has occurred or there is a component problem. Minor (less than 10 divisions) errors can be corrected by matching the recorder traces of the Fast and Slow filter traces to the Medium Filter trace. Use R25 to match the Fast, R26 to match the Slow.

Figure 3



ID 0271-9260 C CHG

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 1%, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 50 VOLTS.

REF. DRAWING

REF	0271-9261
QTY	USED ON

PERKIN-ELMER

SCHEMATIC
FILTER SELECT

D ID 0271-9260 C

C	R&V	2-28-91	
B	DR 14233	1-6-91	
A	1ST ISSUE		
CHG	DESCRIPTION	DATE	CHKD

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PERKIN-ELMER

Instrument
Sales and Service Division
Main Avenue
Norwalk, Connecticut 06856

SERVICE DATA BULLETIN

NO: 271-19

SUBJECT: SHIMS - 3 WAY MIRROR ASSY - LC-85

PREPARED BY: TRAINING AND ENGINEERING DEPARTMENT PAGE 1 OF 3 PAGES

DISTRIBUTION: [X] DOMESTIC [X] INTERNATIONAL [X] DEALERS DATE: 9-4-81

PROBLEM:

To maintain the tight tolerance of the LC-85 optical system, an accurate alignment of the three-way mirror assembly is required upon its replacement.

PURPOSE:

To provide the LC Field Service Engineer with accurate information and a procedure to be used for changing and aligning the LC-85 3 way mirror assembly.

GENERAL:

When replacing a 3 way mirror assembly on an LC-85 Detector, the alignment must be checked after installation as prescribed in the following procedure. If alignment is necessary, shims must be added to the 3 way mirror assembly mounts until proper alignment is achieved.

MATERIALS REQUIRED:

QTY	PART NUMBER	DESCRIPTION
9	990-7763	10 Thousandths Shims

* It is recommended that the Field Service Engineer carry a small supply of these shims in their tool kits.

PROCEDURE:

1. Remove opto/mechanical unit from the LC-85 Detector and install the LC-75/85 Service Legs.
2. Position the opto/mechanical assembly upside down on the service legs. Remove the baffle assembly covering the monochromater housing.
3. Remove the 3 way mirror assembly and replace with a new one.
4. Reinstall the UV Lamp wires from the detector to the UV Lamp wire mounting strip.
5. With the room darkened, turn on the detector power to light the UV Lamp, and turn the monochromater dial to zero order.
6. Place a white card (such as a business card) in front of the reference channel phototube on the electrometer assembly. See Fig. 1.

7. The light pattern visible on the white card should be similar to the pattern in Fig. 2. The dot should be in the center of the circle.
8. If the dot is outside of the center of the circle, a 10 thousandths shim must be added one at a time to the 3 way mirror assembly mounts until the dot is centered in the circle. See Fig. 3.

* Do not add more than 3 shims to any one mount of the 3 way mirror assembly.

9. When proper alignment is achieved, turn detector power off. Replace the baffle assembly on the opto-mechanincal unit, and reinstall the opto-mechanical unit into the LC-85 Detector enclosure. Realign the lamp and flow cell, procedure is complete.

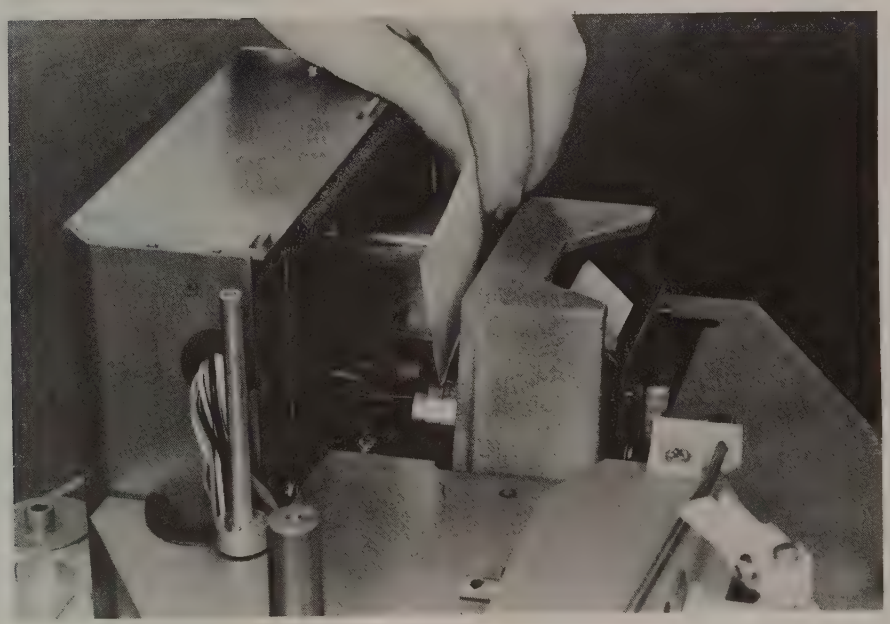
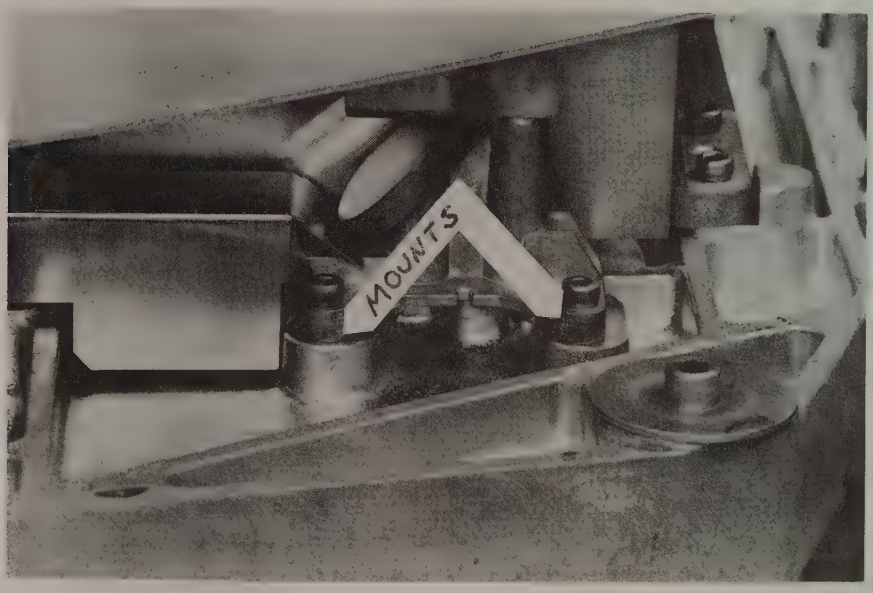


FIGURE 1

FIGURE 2



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1 GENERAL INFORMATION

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1 GENERAL INFORMATION

1.1 DESCRIPTION

The Model LC-85 Spectrophotometric Detector is a dual beam, variable wavelength detector, designed for use in a liquid chromatography system. The detector is a self-contained unit and houses a variable wavelength spectrophotometer, a high-pressure flow-through sample cell, and the electronics required to control the unit.

The detector permits absorbance detection in the ultraviolet-visible range (190 nm to 600 nm). The spectrophotometer is insensitive to flow noise and to changes in the refractive index of solvents.

The standard microcell assembly has a cell volume of 8 microliters and can withstand pressures of 28 Mega Pascals (4000 psig). This capability is required when the flow from the cell is stopped, or when back pressure is applied deliberately to prevent the formation of gas bubbles during gradient elution.

The Model LC-85 can be used with any laboratory recorder requiring a 10 mV input voltage. A recorder with an input range of 0 to 10 mv (full scale) is required.

2 INSTALLATION

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2 INSTALLATION

2.1 PREPARATION

Prepare a sturdy bench location in a clean environment with relatively stable temperature and humidity. The detector operates within the specifications when the ambient temperature ranges from 10°C to 30°C. Ambient relative humidity should be 20% to 80% with no condensation.

2.2 ELECTRICAL REQUIREMENTS

The electrical supply system must be within ±10% voltage tolerance of the nominal voltage for the particular detector in use. A printed circuit board below the line fuse on the LC-85 left side permits the instrument to be used at one of four nominal line voltages. See Section 2.5. A good earth ground is also required, common to all instrument modules and user-supplied attachments. The grounding must be accomplished by a third wire in the electrical supply system. The detector should not be attached to circuits associated with equipment of a heavy-duty nature or large or frequent loads as this may result in excessive noise which may interfere with the detector signal.

2.3 GAS REQUIREMENTS

The detector optical paths are enclosed and purgeable with dry nitrogen to remove UV absorbing solvent vapors. Nitrogen used for this purpose must be pure, clean, dust-free, oxygen-free and preferably boiled-off from liquid nitrogen. Pre-purified tank nitrogen is acceptable. use 1/4-in. fluorocarbon tubing (e.g. Teflon) or equivalent for the nitrogen purge line. DO NOT USE RUBBER OR OTHER TYPES OF PLASTIC TUBING.

2.4 PARTS PROVIDED

The items included in Spares Kit 0271-0345, are shipped with the LC-85 Detector. Those items which are not used during the installation should be stored in a clean, safe location for future use.

2.5 VOLTAGE SELECTION

First, refer to Figure 2-1 and make certain that the small printed circuit board located behind the line fuse (left side panel) is inserted to correspond to the line voltage available. To select the proper operating voltage range setting, remove the AC line cord from the instrument. Slide the clear plastic cover over the fuse all the way to the left. Rotate the FUSE PULL to the left and remove the fuse. Pull out the printed circuit board located below the fuse and orient the printed circuit board so that the desired voltage setting is legible in accordance with the following:

AC Voltage Range	Legible P.C.B. Setting	Fuse
90-110V	100	1.5A
105-129V	120	1.5A
180-220V	220	.8A
217-258V	240	.8A

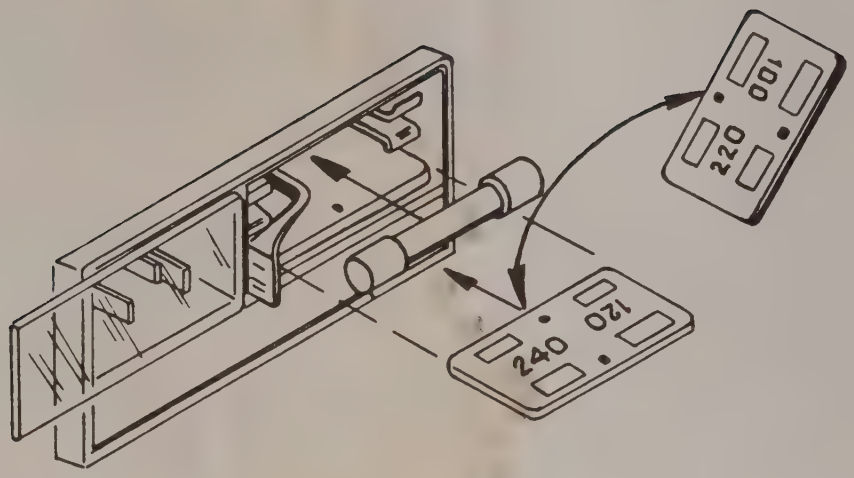


Figure 2-1 - Voltage Selection

Push the printed circuit board back into the slot and rotate the FUSE PULL back into the normal position and make certain that the proper fuse is inserted. Use either a 1.5A (P-E Part No. 0998-1624) or a 0.8 (P-E Part No. 0998-1762) fuse depending on the line voltage. Note that both fuses are provided in the Spares Kit. Use only the proper Slo-Blo fuse.

With the cover down and secured in place and the POWER switch OFF, connect the line cord to a properly-grounded AC outlet.

> Important: All components of the system, e.g., LC-85, the recorder, the solvent delivery module, etc., must share a common ground in the electrical supply system.

2.6 ELECTRICAL CONNECTIONS

2.6A Recorder and Accessory Connections

Use the recorder cable (P-E Part No. 0271-0337) provided to make the appropriate recorder connections at TB501, located on the underside of the detector cover. (See Figure 2-2.) Use the recorder cable to make these connections to a 10 mV recorder:

TB1-7 to Recorder Input (+)
TB1-8 to Recorder Input (-)

1 *TB1*

2 *Source*

3 *Cell Cover*

4 *Solvent INlet Line*

5 *Solvent OUTlet Line*

6 *Purge Hose Fitting*

7 *Filter Board (Beneath Cover)*

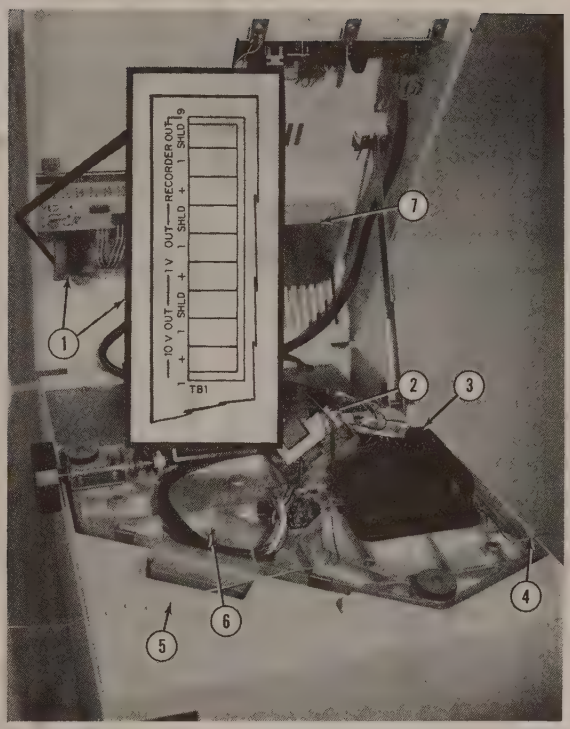


Figure 2-2 - LC-85 (Shown with Cover Lifted)

If a 1 V or 10V data acquisition device is used, use a shielded two-conductor cable or use the recorder cable to make connection to:

1V Device	10V Device
TB1-4 to Data Input	TB1-1 to Data Input
TB1-5 to Return	TB1-2 to Return
TB1-6 to Shield	TB1-3 to Shield

For example, the Perkin-Elmer Sigma Series Console connection is given in Figure 2-3. Connect red to TB1-4, black to TB1-5 and the shield to TB1-6 if a shielded cable is used. The output signal is 1V for 10.00 A_{1cm} where A_{1cm} is absorbance normalized to 1cm pathlength.

The full-scale deflection on the Console, when connected to the 1V output of the LC-85 (TB1-4, TB1-5) is given below. (Make certain that the Console Interface jumper is in the 1 position.)

Console ATT Setting	-4	-3	-2	-1	0	1	2	3	4
LC-85 Full-Scale Deflection (A_{21cm})	.005	.01	.02	.04	.08	16	.32	.64	1.28

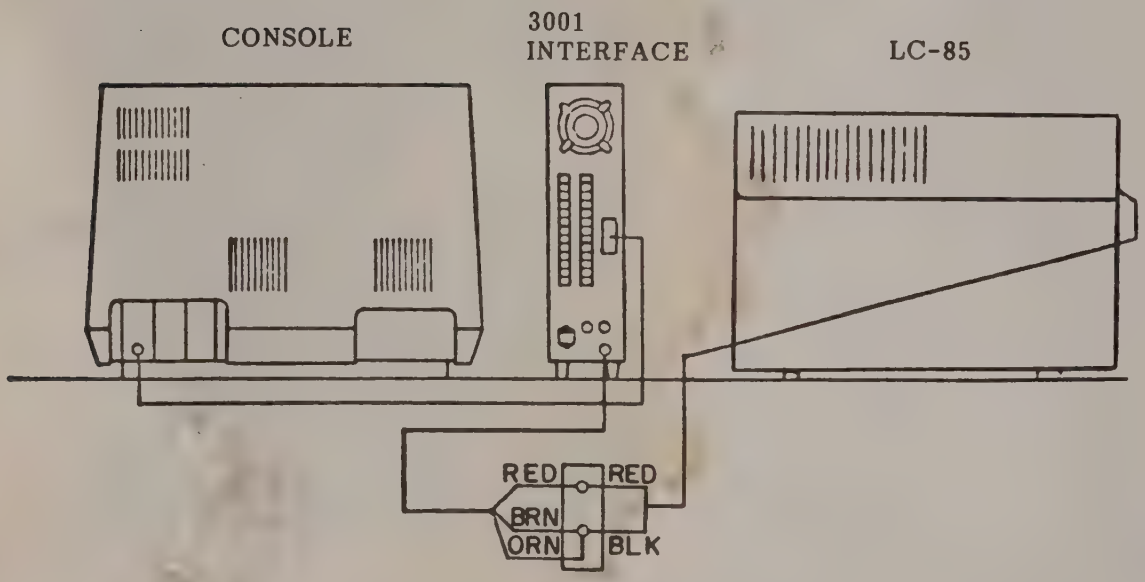


Figure 2-3 - Console Connection

2.7 FLOW CELL SELECTION

The LC-85 is shipped with either the (standard) 8 µl flow cell (P-E Part No. 0271-0338) or the low-volumn 2.4 µl high speed cell (P-E Part No. 0271-0361).

If a detector with a 8µl cell is ordered, and it is desired to replace the cell with a 2.4 µl cell, High Speed LC Kit Assembly 0271-0362 must be ordered. If a detector with a 2.4 µl cell is ordered, and it is desired to replace the cell with a 8 µl cell, cell P-E Part No. 0271-0338 must be ordered. For instructions for installing the cell, see the High Speed Instructions, Appendix 1.

> Important: Use the proper cell for the task being performed. Use only the standard 8 µl flow cell when doing prep scale separations at flow rates above 10 milliliters per minute. At very high flow rates, the pressure limit of the high speed 2.4 µl cell can be exceeded, causing the cell to leak and perhaps damage the optics.
>
> When working with short, high-speed columns, a 2.4 µl cell must be used to prevent loss of resolution of the separated peaks. (In addition to the 2.4 µl cell, injection tubing 0271-1441 and Rheodyne Valve 0990-3602, which are part of the High Speed Injector Kit Assembly P-E Part No. 0271-0363, must be installed.) If an LC-85 detector is ordered with a 2.4 µl cell installed (instrument P-E Part Nos. 0271-0038 and 0271-0039), the Injector Kit Assembly must be installed before doing high speed work.

2.8 OPERATING INSTRUCTIONS

2.8A Controls and Indicators

Item numbers correspond to item numbers in Figure 2-4.

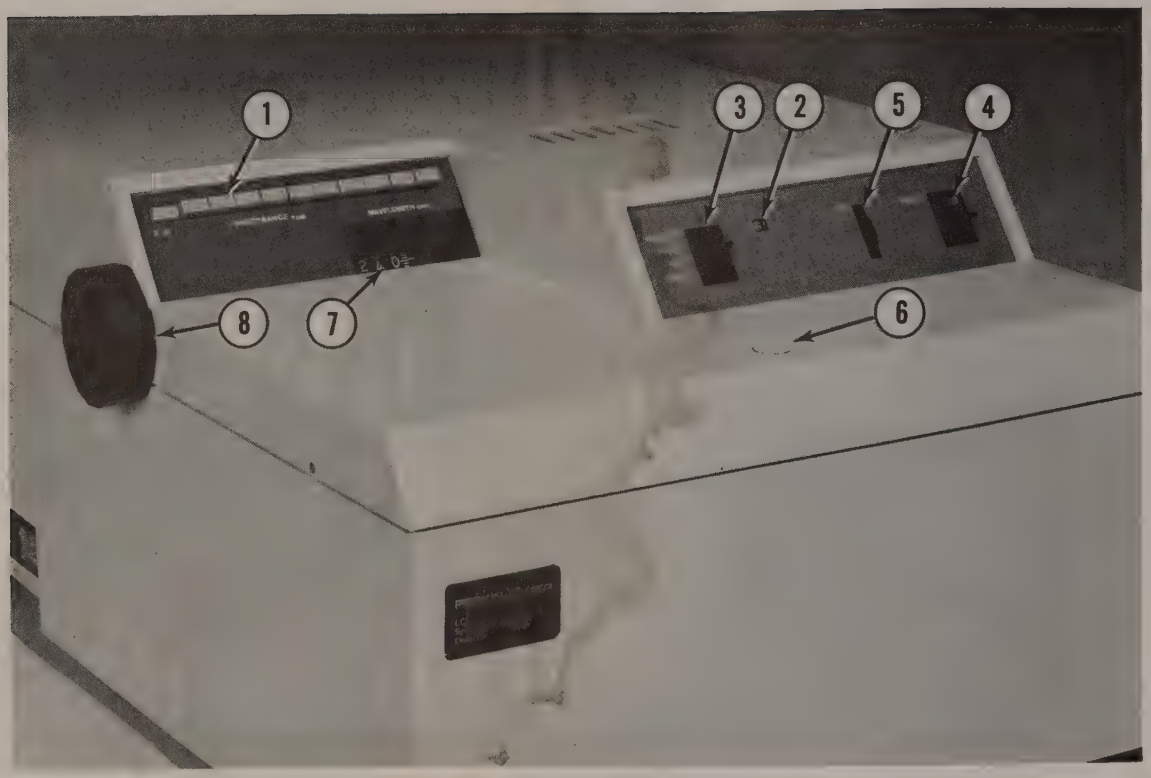
1. $ABSORBANCE_{1cm}$ Range Selector - Eleven-position, push-button binary attenuator adjusts the detector signal to the recorder with the most sensitive setting 0.001 $Absorbance_{1cm}$. One of the attenuator settings must be depressed for the detector to operate.

2. Energy Meter - This zero center meter indicates the energy difference between the sample and reference beams. Full scale reading is equal in absorbance units to approximately $5A_{1cm}$ units.

3. RESPONSE Switch - 3 position switch which allows selection of the electronic response time of the LC-85 to satisfy the needs of the particular analysis. The positions available are FAST, MEDIUM, and SLOW.

4. POWER - Placing the associated switch in the ON (up) position provides power to the LC-85. The POWER pilot light (above the ON-OFF switch) illuminates to verify that the power is on.

5. ZERO Control - Turning this control sets the recorder baseline and data output.



1 ABSORBANCE$_{1cm}$ Range Selector
2 Energy Meter
3 RESPONSE Switch
4 POWER Pilot Light
5 ZERO
6 Cap
7 WAVELENGTH Indicator
8 Wavelength Control Knob

Figure 2-4 - LC-85 Controls and Indicators

6. Cap - The screw under this cap secures the detector cover and must be in place for normal operation.

7. WAVELENGTH (nm) Indicator - This wheel indicator provides a three digit and first decimal place readout of the wavelength setting, graduated in 0.2 nm increments readable to 0.1 nm.

8. Wavelength Control Knob - Turning this knob sets the detector wavelength.

Important:

1) Do not force the control knob below the 000.0 nm setting or above the 900.0 nm setting.
2) For repeatability, always approach the desired wavelength from the low side.

2.9 OPERATING SUMMARY

a) Connect the INlet line to the column outlet. If unions are used, make certain that they are of the zero-dead-volume-type (P-E Part No. 0990-3259).

b) Connect the detector signal outputs to the recorder and/or data system.

c) Turn ON the LC-85 POWER. Allow 15-30 minutes minimum warm-up times. (Allow approximately 1 hour for maximum sensitivity setting.)

d) Select the LC pumping system flow rate and detector compatible solvent composition; begin pumping. Make certain that all plumbing connections are leak-free.

e) Allow the flow rate to stabilize. (Observe the pumping system pressure.)

f) Use the detector WAVELENGTH dial to select a wavelength appropriate for the analysis. Make certain that the wavelength chosen is above the UV cutoff for the solvent(s) in use. (If the sample absorbance wavelenght is unknown, use 250 nm initially as many compounds absorb at this wavelength.)

g) Select the ABSORBANCE$_{1cm}$ setting. (The ABSORBANCE$_{1cm}$ push button control is used to keep the peaks on-scale. A setting of 0.16 is typical.)

h) Observe the baseline until stable. Adjust the signal to 0 to 10% of the recorder scale with the ZERO control.

i) Inject the sample.

   1) If the peaks go off-scale, select a higher number ABSORBANCE$_{1cm}$ setting to make the peaks smaller. (If a data acquisition device (e.g. P-E Sigma Series Console) is in use, peaks may be allowed to go off-scale.

   2) If the peaks are too small, use a lower number ABSORBANCE$_{1cm}$ setting.

2.10 SYSTEM CHECK OUT

2.10A Materials Required

1. Recorder
2. Series 1,2 or 3B pump with injector
3. C8 Reverse Phase Column
4. Filtered, degassed acetonitrile
5. Filtered, degassed, distilled water

2.10B Checkout Procedure

1. Mix 200 ml of 60% acetonitrile with 40% water (used as the mobile phase).

2. Make the following settings on the LC-75 detector
   a) Power Switch - ON
   b) Wavelength - 254 nm
   c) Attenuator - X76

3) Make following settings on the recorder:
   a) Recorder Power - ON
   b) Chart Speed - 5 mm/minute
   c) Range - 10 mv FS
   d) Polarity - minus (-)
   e) Recorder Zero - Adjust zero to bring recorder pen to the right side of the chart paper.

4) Make the following settings on the Series pump:
   a) Pump Power - ON
   b) Mode - Independent
   c) Flow - 2 ml/minute
   d) Pump A if Series 2 or 3B is used - ON

5) Use the LC-85 Fine Zero control to adjust the recorder pen to the right hand side of the chart paper.

6) Place the injector to the Load position. Load injector with 5 µl of bubble free Reverse Phase Test Mix (0089-0936).

7) When you are ready to inject, rotate the injector to the inject position and simultaneously mark the chart paper by switching the Polarity switch from Minus to Plus and back to Minus.

8) The chromatogram should be completed in less than 12 minutes. Note that the peaks are well separated with a reasonable return to baseline between them. See Figure 2-5.

3 THEORY OF OPERATION

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3 THEORY OF OPERATION

3.1 GENERAL

3.1A LC-85 Detector Operation

This section covers the theory of operation and circuit description for the LC-85.

The LC-85 is a variable wavelength dual beam Ultra-Violet Optical Detector for Liquid Chromatography.

A deuterium lamp, excited by a DC lamp power supply is aligned to transmit maximum UV energy into a monochromator. The monochromator, which utilizes a grating, allows for maximum efficiency of the transfer optics. From the monochromator, light pases through a 3 position optical filter, one of the positions is an air filter. The filters change at 325 and 525 nanometers. The filtered light passes through the transfer optics to a beam splitter. One half of the split beam passes through the flow cell to the sample phototube; the other half directly to the reference phototube.

The electronic signals generated at the phototubes is sent to an electrometer. Here the signals are log converted. This is done to make Beer's Law correlations. Beer's Law states that:

Abs (Absorbance) = abc

where Abs is the amount of light absorbed by the sample.

a is a physical constant of the sample.

b is the pathlength of the flow cell.

c is the concentration of the sample.

Since ABs or Absorbance is directly relatable to c or concentration it is preferable to work in those units.

A phototube does not measure the amount of light a sample absorbs, but rather the amount of the light that is transmitted through the sample. There is a mathematical relationship between absorbed and transmitted light.

$Abs = (\log - 10\ T)$

where Abs is Absorbance

T is the fraction of light transmitted

For Example: A flow cell's contents transmits .99 of the incident light. Calculate the Absorbance.

$Abs = -(\log 10\ .99)$

$Abs = -(-.0044)$

$Abs = 0.0044$

For this sample the ABSORBANCE is 0.0044.

Both the sample and reference beams are log converted. The sample signal is subtracted from the reference signal. If both channels were equal before the presence of a sample in the flow cell, the net signal would be zero. If a sample absorbs light, the difference is no longer zero. The subtraction is done by an instrumentation amplifier.

After subtraction, the signal is processed by one of three user selectable active filters. These are called slow, fast and medium. The LC-85 is designed to perform high speed, normal analytical and preparative liquid chromatography. This multimode capability requires the three response times. The active filters are of the three-pole Bessel type.

The signal is next processed by an interface and scaling circuit. The LC-85 can be equippped with either of two flow cells. An 8 microliter flow cell with a 6 millimeter pathlength is used for preparative and normal analytical work. For high speed work a 2.4 microliter flow cell with a 3 mm pathlength is used.

The LC-85 is calibrated in standard absorbance sub one centimeter or A_{1cm} units. As mentioned earlier, Beer's law states:

$$Abs = abc$$

If both sides of the equation are divided by b, the pathlength, expressed in centimeters, is equal to:

$$A_{1cm} = ac$$

If the gain of the interface is modified by a factor equal to the inverse of the pathlength, the output is in standard units.

The final stage of signal processing is done by an attenuator. The ten volt output has an analog value of 1.0 volts per A_{1cm} unit. the one volt output has an analog value of 0.10 volts per A_{1cm} units.

The recorder output is jumper selectable for either a 10, 5, or 2.5 millivolt recorder. There are eleven output ranges in binary step from 0.01 to 10.24 absorbance sub one centimeter units equal to full scale on the recorder.

3.1B Optical System Operation (See Figure 3-1)

The energy from the lamp strikes a curved mirror. The curved mirror, M1 reflects the light to the monochromator. The light passes through the entrance slit and strikes a curved mirror, M2. M2 is the folding mirror; it reflects the light to the grating. The LC-85 uses a holographic grating. The grating disperses the lamp's energy into a spectrum. The spectrum strikes M2 and M2 reflects it upon the exit slit.

Since the spectrum covers a fairly large area only, the wavelength that falls upon the slit is passed through. The spectral bandwidth of the LC-85 is 2.6 nonometers at 600 nanometers.

After leaving the monochromator, the monochromatic light is reflected by a torroidal mirror, M3, to a flat mirror, F1. F1 redirects the light through a mask to a flat mirror F2 that has a hole drilled through it. Fifty per cent of the light passes through the hole and the remainder is reflected.

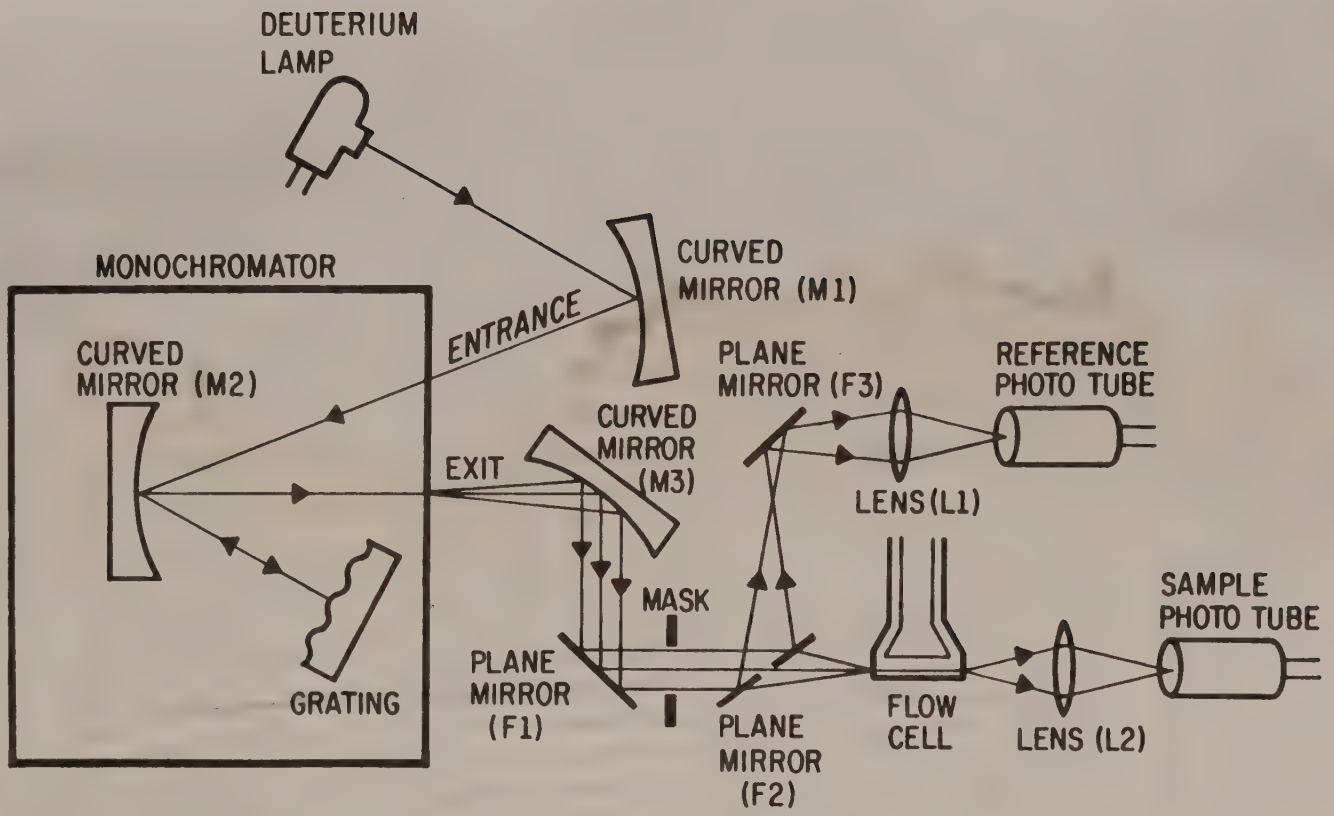


Figure 3-1 - LC-85 Optical Systems

The light that passed through F2 is focused to a point inside the flow cell. The light diverges and is collected by a lens, L2, and focused on the photo cathode of the sample phototube.

The light that was reflected by the beam splitter, F2, is redirected by another flat mirror, F3. Lens L1 collects the light from F3 and focuses it on the photo cathode of the reference phototube.

3.2 ELECTRONIC THEORY OF OPERATION

3.2A Power Supply and Lamp Driver Circuit Description

The Power Supply and Lamp Driver are identical to those of the LC-75. Refer to Section 3.2C in the LC-75 section of this manual.

3.2B Electrometer, Log Amplifier PCB Circuit Description (Ref. Schematic 0271-9080)

In order to improve the baseline stability of the LC-85 over that of its predecessor (the LC-75), dual beam optics are implemented. The LC-85 is a DC electronic, dual beam instrument. No rotating beam choppers are used. there is no need for a chopper demodulator (phasing) circuit. The sample and reference beams are fixed and treated the same way by matched sample and reference electronic channels. See Figure 3-2.

If the flow cell does not contain any substance that absorbs the monochromatic light, the sample and reference electronics should be balanced. This is referred to as a "Common Mode" Signal. There is an Instrumentation Amplifier (IA) that subtracts the signals and amplifies the difference. A measure of IA performance is the amount of Common Mode Signal that is passed. The ratio of the Common Mode Signal, divided by the portion that is passed, is called the Common Mode Rejection Ratio or CMRR.

The output of the IA is the UV absorbance of the contents of the flow cell. Depending on the type chromatography being performed a slow, medium, or fast time constant must be chosen. This is user selectable. The filtration is achieved by use of operational amplifier active filter circuits. The medium filter is located on the Log Amplifier/Electrometer PCB. The slow and fast filters are located on the Filter Select PCB.

1. Phototube Power Supply

Both the sample and reference phototubes are Hamamatsu R1105 vacuum tube photodiodes. The bias or acceleration voltage is derived from the -15VDC supply. The -15VDC is applied through R23 to the anode of CR1. The cathode of CR1 is connected to the anode of CR2. The cathode of CR2 is connected to ground. Two zener diodes, which prevent power supply fluctuations from affecting the phototubes, develop a -12.4VDC. The -12.4VDC is applied to the photoactive cathodes of the tubes.

2. Sample and Reference Amplifiers

The sample and reference amplifiers are identical except for component designations. This section deals only with the sample section, as it is the more dynamic.

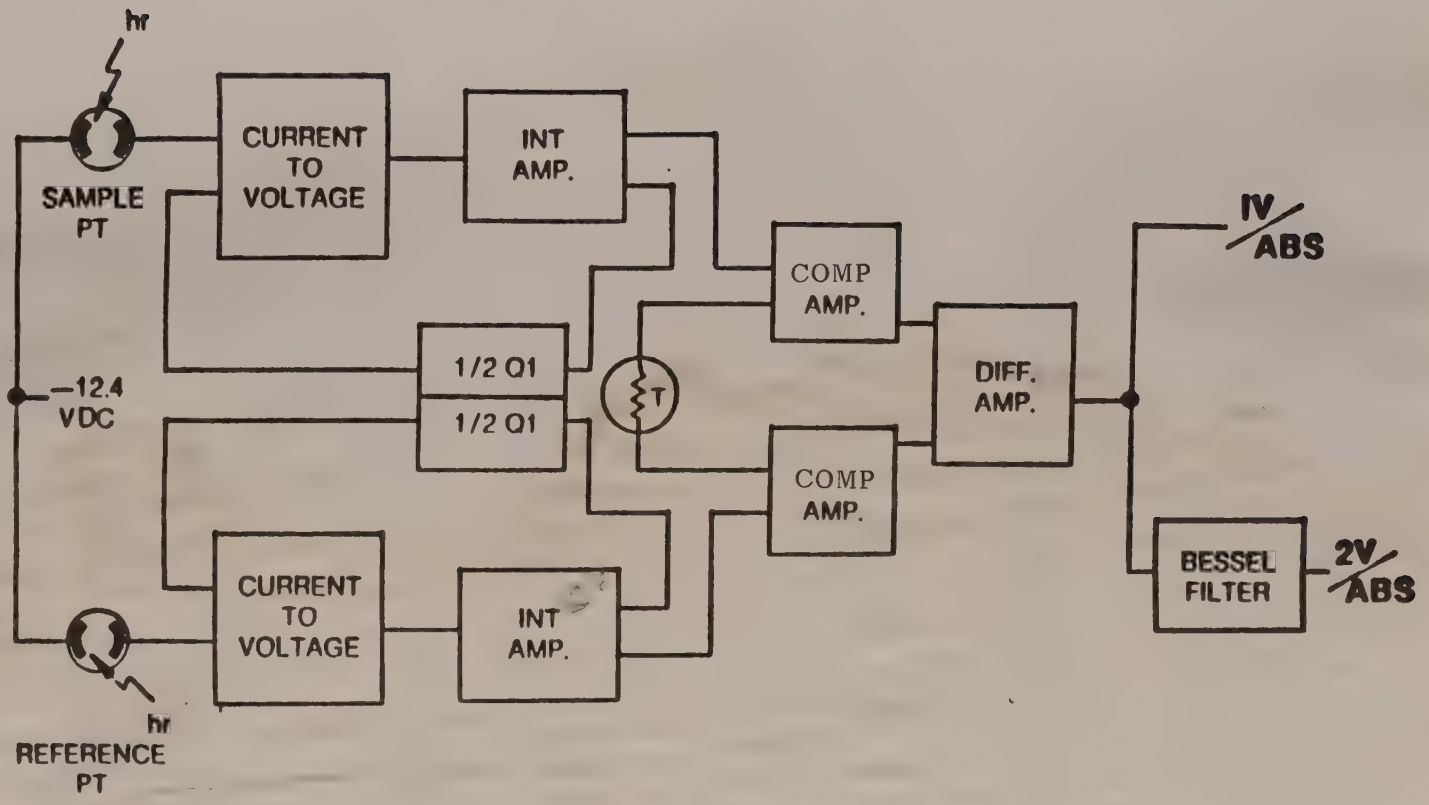


Figure 3-2 - Log Amplifier PCB Block Diagram

When the contents of the flow cell do not absorb any of the monochromatic light, maximum illumination of the photo cathode occurs. Maximum illumination knocks maximum electrons from the photo cathode. These electrons are accelerated towards the anode by the voltage difference of -12.4VDC and ground seen through Op Amp IC1. IC1 is a current-to-voltage converter. The voltage seen at IC1, pin 6 is applied to IC3. IC3, an integrator, has a resistive input with a capacitive (C3) feedback. The output from IC3 flows across SP4 through R12. The signal is split at the junction of R12 and pin 3 of P/O Q1. The portion of signal that flows through Q1, emitter-to-collector, is fed back to IC1 on pin 2. The remainder of the signal is sent to the Instrumentation Amplifier.

To reiterate, IC1 acts as a current-to-voltage converter. IC3 is an amplifier that provides integration. Both amplifiers IC1 and IC3 are used as a gain "block". Their overall voltage output is a logarithm function of the input current. The log conversion and overall gain of the "block" is controlled by the action of Q1.

3. Instrumentation Amplifier

The outputs from the sample and reference log amplifiers are combined by the Instrumentation Amplifier (IA). The IA used in the LC-85 is comprised of three operational amplifiers. The two halves of IC5 are matched OP-10's. They increase the signal strength on both the sample and reference signals; their outputs are routed to IC6, a 741K. Figure 3-3 is a simplified schematic of the IA. The overall gain of this circuit block is theoretically calculated in Table 3-1. The actual gain is 16.667.

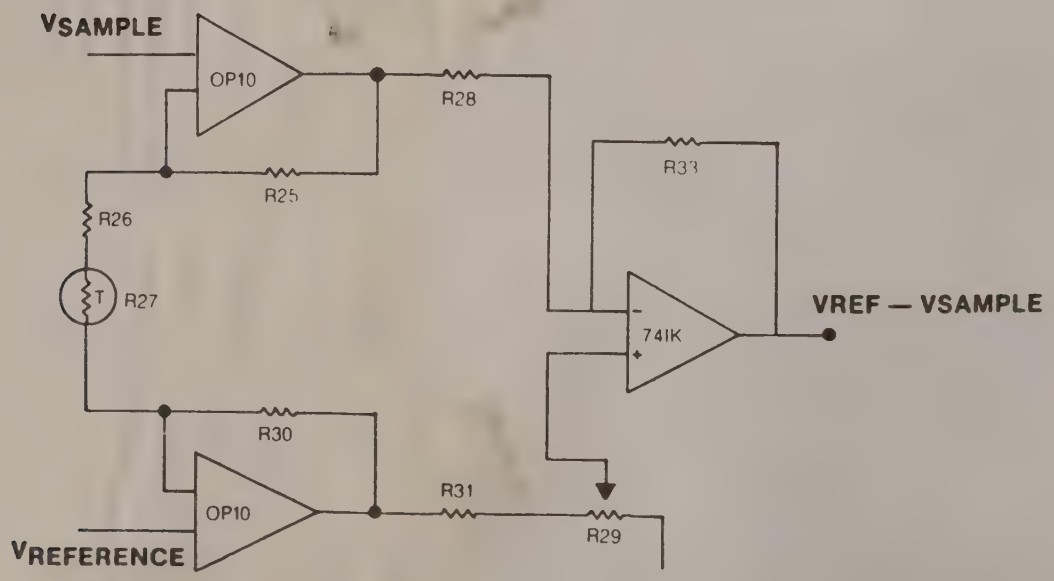


Figure 3-3 - Instrument Amplifier Schematic

The main component that affects the gain is R27. It is located in close physical proximity to Q1 in the log amplifiers. The log transistors are the most heat susceptible component. If their temperature rise, their output increases. To compensate for this affect, R27 has positive temperature co-efficient. An increase in temperature sensed near Q1 increases the resistance of R27 and decreases the overall gain of the IA. This keeps the overall signal constant. The signal has an analog value of 1.0 volt per Abs at the output of the IA.

Table 3-1

$$\text{GAIN} = \frac{R33}{R31}\left(1 + \frac{R25}{R26 + R27} + \frac{R30}{R26 + R27}\right)$$

$$\text{GAIN} = \frac{20K}{20K}\left(1 + \frac{14.3K}{1806} + \frac{14.3K}{1806}\right)$$

$$\text{GAIN} = 16.8$$

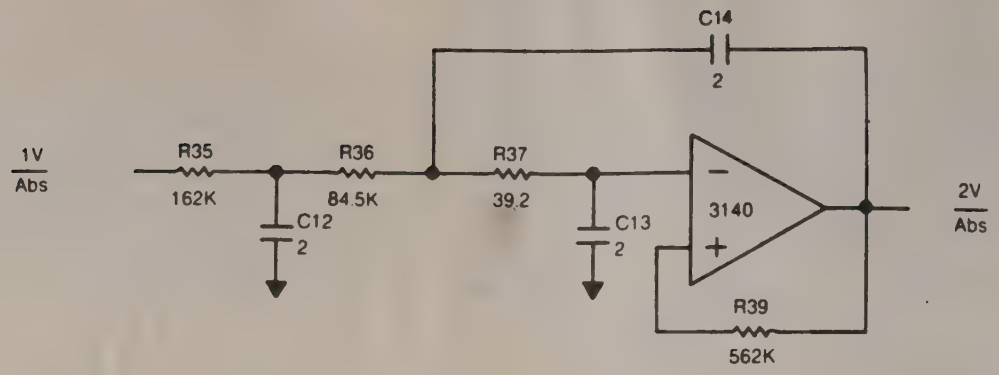
After the IA, the signal splits, it goes to the Bessel filter on the Log Amp or to the Filter Select Circuit.

4. Bessel Filter and Amplifier

The final circuit section of Electrometer/Log Amplifier is the Bessel Filter. This is an operational active filter of the low pass variety. The roll off frequency is 3Hz. A simplified version of the filter is shown in Figure 3-4.

The time constant of this amplifier is determined by R35, R37, C12, C13, and C14. The gain of this amplifier is the ratio of the feedback resistor R39 to the total series resistance of R35 plus R36 plus R37. this computes to the theoretical value of 1.97.

The 3140 is a CMOS device. Diodes CR5,6,7, and 8 are used to protect the amplifier from over voltage inputs and noise.



$$\text{GAIN} = \frac{\text{R39}}{\text{R35 + R36 + R37}}$$

$$\text{GAIN} = \frac{562\text{K}}{285.7\text{K}}$$

$$\text{GAIN} = 1.97$$

Figure 3-4 - Simplified Version of Filter Amplifier

3.2C Circuit Description of the Filter Select PCB (Ref. Schematic 0271-9260)

The LC-85 is designed to be a multi-mode chromatography detector that is required to process very fast signals and very slow signals. This is accomplished by allowing the user to select a response time. The selection actually chooses one of three operational amplifiers (active filters). These filters are of the three pole Bessel type. The filters are labeled Slow, Medium, and Fast. They are low pass filters and have a pass frequency of 0.04 Hz, 0.4 Hz and 4.0 Hz; respectively. The filters are chosen by means of a front panel mounted switch.

The Filter Select PCB contains the following circuits:

1. +5 VDC supply
2. +13 VDC supply
3. -2 VDC supply
4. -1 VDC test for electrometer
5. Switch Control Circuit
6. Slow Active Filter
7. Fast Active Filter

3.2D Power Supplies

1. +5V Supply - The +5 VDC supply is generated from the +15 VDC by VR1. The +15 VDC is input to the board on P801 pin 2. Pin 2 is connected to pin 1 of VR1; a three terminal 5 volt regulator. 5 VDC is output from VR1 on pin 2. C1, C2, CR1 and CR2 are used for filtering and noise suppression.

2. +13V Supply - The +13 VDC is derived from the +15 VDC by applying a voltage divider, R4 and R5, from +15 VDC to ground.

3. -2V Supply - The -2 VDC is derived from the -15 VDC by using a voltage divider, R6, and R7, from -15 VDC to ground.

4. -1V Supply - The -1 VDC test signal is derived from both -15 VDC and +15 VDC. A voltage divider consisting of R28, R92, R30 and R37 generates the signal. The -1 VDC test is generated at the junction point of R28 and R29. This signal is fed to position C of both jumpers SP5 and SP6. Potentiometer R30 is adjusted for 0.0 VDC. This signal is sent to position A on both SP5 and SP6. Both jumpers are normally in the AB position. Applying 0.0 VDC to the test circuit in the electrometer should have no effect on normal instrument operation.

3.2E Switch Control Circuit

The switch control circuit is comprised on Switch S702, Integrated Circuits IC3, IC2 and IC5. This circuit switches two outputs from the Log Amplifier PCB. The first signal is the 2.0V per Absorbance Unit.

This signal has already passed through a three pole Bessel filter. The second signal is the 1.0V per Absorbance Unit from the Instrumentation Amplifier. The 1.0V per Absorbance Unit signal is split into the Slow and Fast signals, filtered, and amplified.

With S702 in the Fast position, a ground is applied to Pin 5 of IC2. This turns off the opto-coupler. With the transistor off, pin 11 is pulled up to +13 VDC. IC's 2 and 5 are MOS devices and interpret this voltage as a logic high. With switch S702 in the Fast position, the 1.0V signal is sent through IC2 on pins 8 to 9. The Fast signal is filtered and amplified by a factor of two by IC4. The sample logic high now sends the Fast signal through IC5 on pins 9 to 8. The Slow signal is treated in exactly the same way except for its signal path. The Slow signal goes through IC2 on pins 1 to 2, is amplified and filtered by IC1, goes through IC5 on pins 2 to 1. The path for the medium signal is through IC2 on pins 3 to 4 through IC5 on pins 4 to 3.

Only one of the three signals can cross the circuit. The chosen signal is now sent to the Interface PCB.

3.2F Slow and Fast Bessel Filters

The operation of the Slow Bessel filter, IC1, is identical to that of the Bessel filter discussed earlier in the log amplifier section except the pass frequency is 4.0 Hz.

The operation of the Fast Bessel filter, IC4, is identical to that of the Bessel filter discussed earlier in the log amplifier section except the pass frequency is 0.04 Hz.

3.2G Interface and Attenuator

The Interface and Attenuator in the LC-85 are identical to those in the LC-75 with the exception of capacitors C_1 and C_2 on the Attenuator. On the LC-75 they are 220μf; on the LC-85 they are 10μf. This is done to enhance the high speed capability of the LC-85.

4 MAINTENANCE AND TROUBLESHOOTING

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4 MAINTENANCE AND TROUBLESHOOTING

4,1 Alignment Procedures

4.1A D_2 Lamp

The D_2 lamp is aligned by blocking the sample beam, placing a fixed voltage on the sample electronics input and using the reference electronics to monitor the lamp intensity signal while adjusting the lamp. The output of the final differential amplifier represents maximum lamp energy through the reference electronics which is presented as maximum absorbance.

When adjusting the flow cell, the fixed voltage is removed from the sample electronics input and the flow cell is adjusted so that maximum UV light strikes the sample photo-tube when there is no sample present in the flow cell. Since the lamp is not being adjusted, the reference channel now has a fixed voltage on its input. this fixed voltage is provided by the UV lamp energy striking the reference photo-tube.

While adjusting the flow cell, the output of the differential amplifier on the electrometer assembly represents maximum energy striking the sample photo-tube with no sample in the flow cell, which represents minimum absorbance. It is important to understand that because the sample circuit on the electrometer feeds the opposite input of the final stage differential amplifer rather than the reference circuit, the flow cell peak shows up on the chart recorder in the opposite direction from the peaking of the lamp.

To align the D_2 lamp proceed as follows:

1. Replace the flow cell cover with the test cover. (P-E Part No. 0271-1298)

2. The sample beam must be blocked. If a dummy flow cell is available, cover the through hole with a piece of thick electrical tape. Do not put tape on a standard cell because the adhesive can contaminate the windows. If a dummy cell is unavailable, the flow cell body may be used to block the beam.

3. Turn the flow cell horizontal adjust screws (the one towards the front of the detector) completely counterclockwise. This moves the flow cell body into the path of the UV light going to the sample photo tube, thus blocking it.

4. Locate jumper SP-6 on the filter select PC board and place it in the BC position. This places a --1v test voltage on the input of the sample electronics on the electrometer assembly. Also check to be sure SP-5 is in the AB position. See Figure 4-1.

5. Set the attenuation to 16, use the LC-85 zero control to bring the chart recorder pen on scale. Then set the attenuator to 8.

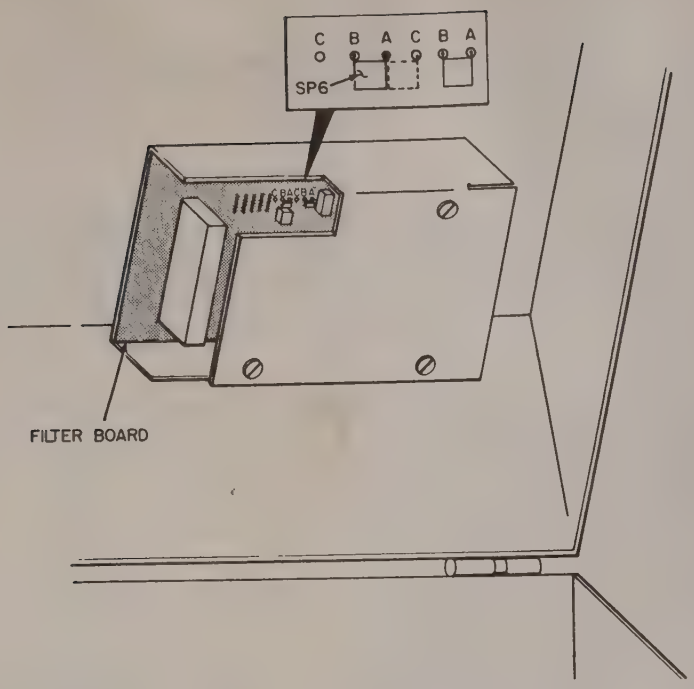


Figure 4-1 - Jumper SP6 and the Filter Board

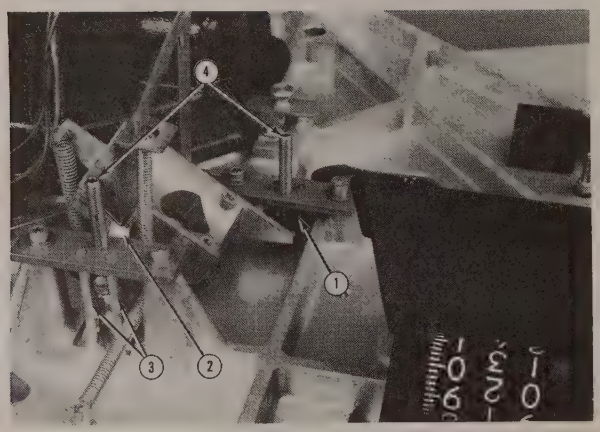
6. Using the two lamp adjust screws on the lamp mount assembly, adjust the lamp for a maximum absorbance indication (downscale pen). This is an indication of increasing lamp energy being monitored through the reference channel of the electrometer. See Figure 4-2.

   Note: If there is any doubt as to which direction on the chart recorder represents increasing lamp energy, depress the lamp mount assembly to move the light beam off of the UV entrance. The chart recorder indicates decreasing energy through the reference channel of the electrometer (giving a maximum absorbance indication).

7. When the lamp is peaked, replace SP-6 to the AB position on the filter select board.

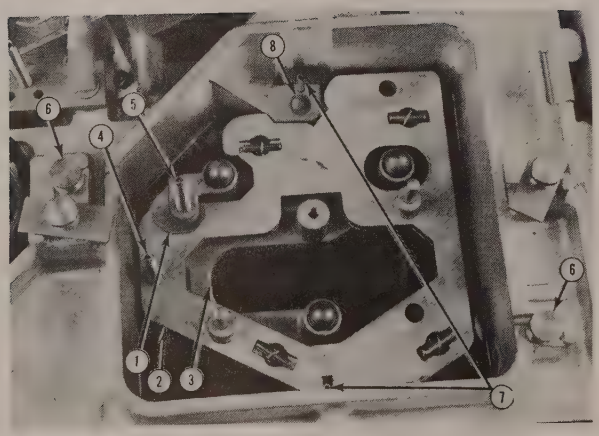
4.1B Flow Cell

Peak the flow cell for minimum absorbance or in the opposite direction from peaking the lamp. Remember this is being monitored through the sample circuit on the electrometer assembly. See Figure 4-3.



1) Stainless Steel Plate
2) Stainless Steel Clip
3) Slider Pins
4) Nylok Adjustment Screws

Figure 4-2 - Nylok Adjustment Screws



1) Stainless steel plates
2) Upper cell plate
3) Lower cell plate
4) Front nylok adjustment screw
5) Rear nylok adjustment screw
6) Inlet & outlet thumb screw
7) Locating pins
8) Ball bearing for flow cell plates

Figure 4-3 - Cell Adjusting Screws

4.1C Power Supply

The power supply has only one adjustment other than the line voltage selection. There are several sub circuits that do have tolerances. Measuring voltages at various places in the circuit allows troubleshooting by subsection.

4.1D Electrometer Alignment (Refer to Schematic 0271-9080)

1. Because there are very high impedence devices on this PCB, replacement of components located to the left of SDP5 and SP9 (in the schematic) is not recommended. If a faulty component is found in this region, replacement of the entire Log Amp/Electrometer Assembly is recommended (0271-9084).

2. Access to the LC-85 Electrometer is virtually identical to that of the LC-75. Proceed as follows:

   a. Unplug the LC-85 from AC power.
   b. Remove the cable that carries the high voltage to the D_2 Lamp.
   c. Disconnect the two Amphenol connectors located on the casting. Remove the cable from the snap connectors.
   d. Remove the three screws that secure the rubber grommets.
   e. Remove the grommets.
   f. Remove the Optical/Mechancial assembly.
   g. Install the service legs.
   h. Remove the six clamps holding the "turkey pan" to the casting.
   i. Lift the casting free from the pan and turn upside down on the service legs.
   j. Locate the two pan head screws that secure the lift off cover to the electrometer box; remove the screws and the cover.
   k. Be very careful with the wire bundle on the right hand side of the electrometer. This harness is very tight on the LC-85's shipped before September 1, 1981.
   l. Remove the cover from the power supply.
   m. Locate and remove F102 from its holder. All the signals needed to set up the electrometer are generated on the board. There is no need to operate the D_2 Lamp. Removing the fuse eliminates any danger to either personnel or equipment.
   n. Reconnect the two blue Amphenol connectors to the casting connectors.
   o. Plug the instrument into a source of AC power.
   p. Turn the instrument ON and allow 15 to 20 minutes warm up.

   Note: Do not allow drafts to strike the electrometer. This will activate the temperature compensating circuit and give erroneous results. Never touch the components with fingers. This can cause false results.

   q. Connect minus lead of DVM to TP10.
   r. Place SP1 to the AC positon.
   t. Remove SP2 and SP6.
   u. Ground feed through E8.

v. Ground feed through E10.
w. Adjust R3 for 0.000 VDC ±0.001 at TP1.
x. Adjust R14 for 0.000 VDC ±0.001 at TP4.
y. Place SP3 to AB and SP7 to AB.
z. Adjust R11 for 0.000 VDC ±0.001 at TP2.
aa. Adjust R22 for 0.000 VDC ±0.001 at TP5.
bb. Place SP3 to CB and SP7 to CB
cc. Place SP5 to BE and SP9 to BE
dd. Adjust R24 for 0.000 VDC ±0.001 at TP7.
ee. Adjust R34 for 0.000 VDC ±0.001 at TP9.
ff. Adjust R40 for 0.000 VDC ±0.001 at E12.
gg. Place SP5 to CF and SP9 to CF.
hh. Adjust R29 for 0.000 VDC ±0.001 at TP9.
ii. Place SP9 to BE. The voltage at TP9 should be approximately -5.33V or -0.533V, record this voltage.
jj. Place SP9 to CF and SP5 to BE. The voltage at TP9 should be approximately +5.33V or +0.533V , recorder this voltage.
kk. Divide the two results. If the quotient does not equal 1.00 either an error was made in the setup or there is a component problem.
ll. If a source of cold (circuit cool or freon) is available, gently chill R27. Do not chill R27 to the point that allows condensation on the circuit board. As R27 cools, the voltage at TP9 should increase.
mm. Measure the voltage at TP9 and record it.
nn. Measure the voltage at E12.
oo. Divide the E12 voltage by the TP9 voltage. If the results are between 1.95 and 2.05V the Bessel filter is working properly.
pp. Place SP9 to AD and SP5 to AD.
qq. Reinstall SP6 and SP2.
rr. Place SP1 to AB.
ss. Replace cover on Electrometer and perform steps a through j in reverse sequence.

4.1E Filter Select Alignment

See Service Data Bulletin in 271-17 in Appendix 1.

4.1F Interface and Attenuator

To be provided at a later date.

4.2 OPTICAL CLEANING

4.2A D_2 Lamp

D_2 lamp cleaning in the LC-85 is identical to the procedures used on the LC-75. Refer to Section 4.5A in the LC-75 section of this manual.

4.2B Flow Cell

1. The standard LC-85 flow cell cleaning procedure is identical to the LC-75. Refer to Section 4.5B in the LC-75 section of this manual. The high speed cell has different springs.

2. Use springs (0271-1385) on the standard cell and springs (0271-2234) on the high speed cell.

   Important If springs (0271-1385) are installed on a high speed cell, the cell windows may crack.

4.2C Transmission Optics

Refer to section 4.5C in the LC-75 section of this manual.

4.3 3-WAY MIRROR SHIMS REPLACEMENT

See Service Data Bulletin 271-19 in Appendix 1.

4.4 SERVICE AIDS

The LC-85 uses the same service aids and fixtures as the LC-75, refer to Setion 4.2 of the LC-75 section of this manual.

4.5 PREVENTIVE MAINTENANCE

4.5A Lamp

The D_2 lamp has a life expectancy of approximately 500 hours. As the lamp approaches the end of it's useful life, the baseline noise may increase or the instrument drift increases. The lamp may lose dueterium gas over it's life. This is indicated by a drop in the lamp voltage. Lamps with less than 70 VDC from the anode to cathode are considered defective.

When the lamp circuit is changed, the lamp driver circuit requires adjustment. Place the leads of a voltmeter on TP8 and TP4 (across lamp current sensor R9). Adjust R12 for a voltage of 0.5V.

The flow cell should be repeaked every time a lamp is changed.

4.5B Flow Cell

If the flow cell becomes contaminated (detector input decreases, drifts, or becomes noisy), flush the flow cell. As general routine maintenance, flush the flow cell every six months. If preparative scale chromatography is performed the cell should be flushed more frequently. See Section 4.5B of the LC-75 section of this manual.

4.5C Source Optics

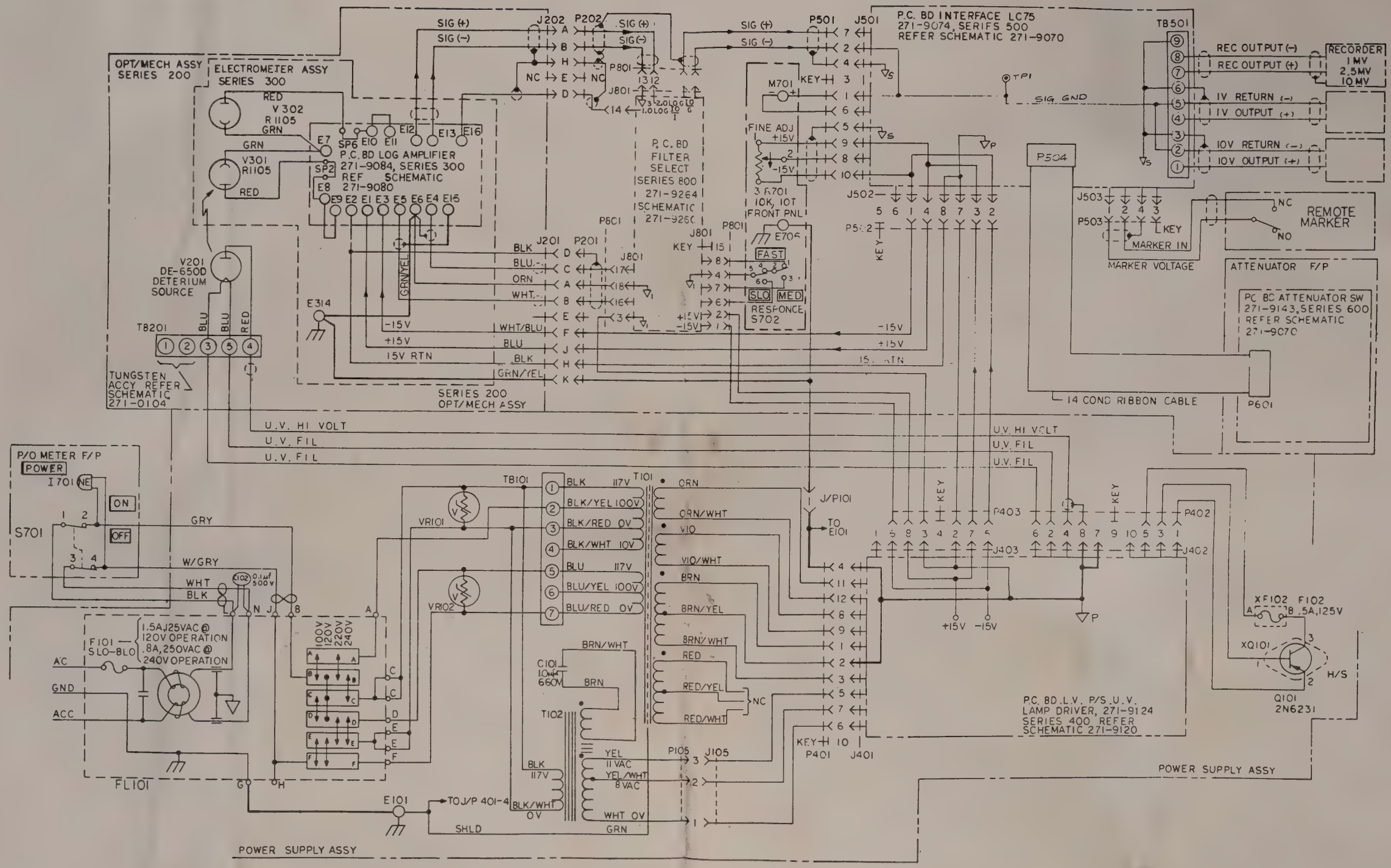
On both the LC-75 and the LC-85 the source optic is a reflective mirror. This mirror is exposed to the entire output of the lamp. After extensive (usually in excess of 2000 hours use), the coating may degrade. It is recommended that the mirror be replaced every 2 years.

5 SCHEMATICS

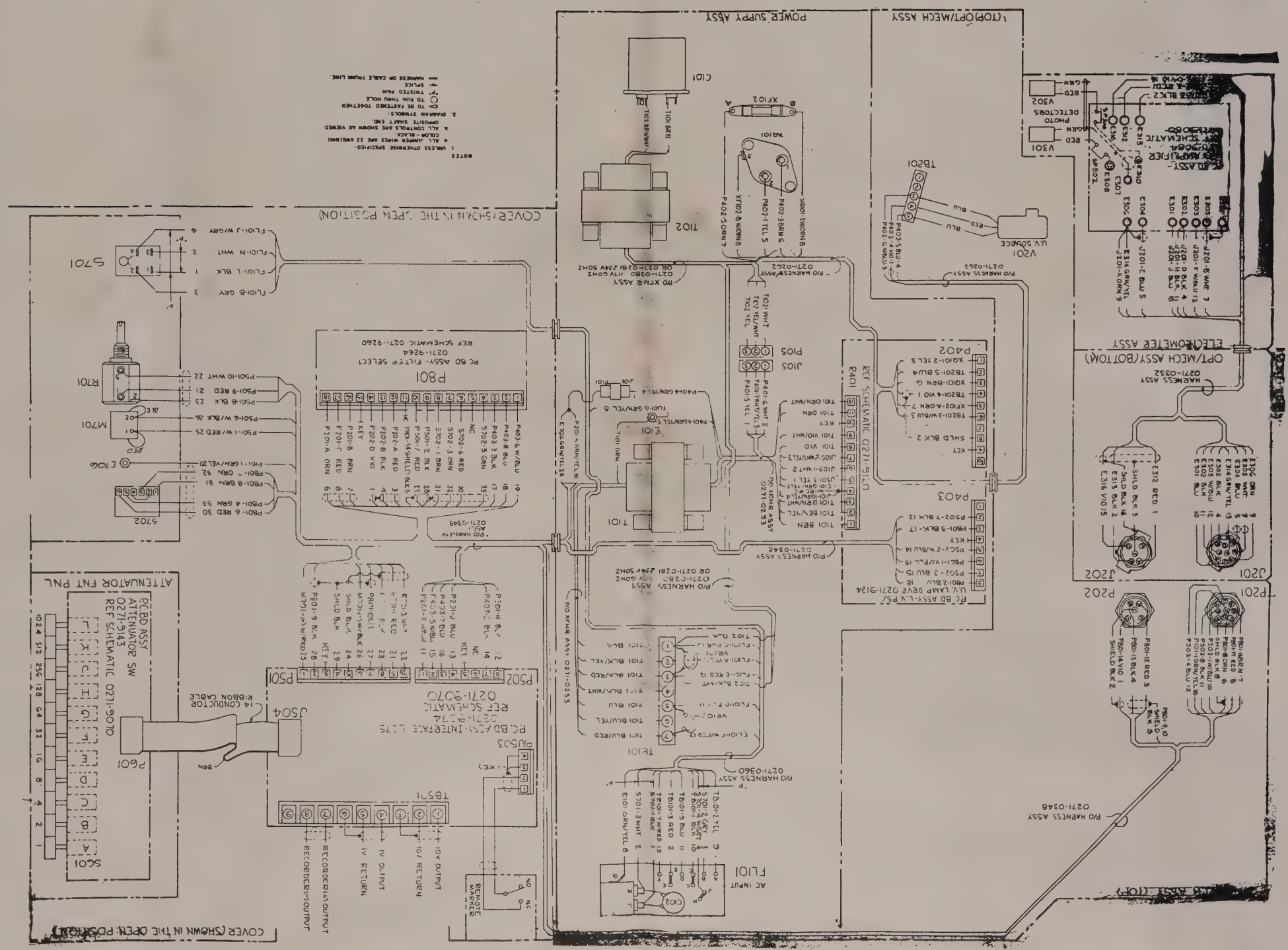
5 SCHEMATICS

5.1 DESCRIPTION

This section is a compilation of schematics required to support circuit descriptions and assist in troubleshooting the LC-85 .



Interconnection Diagram
0271-0106


POWER SUPPLY ASSY
(TOP)OPT/MECH ASSY
OPT/MECH ASSY(BOTTOM)
ELECTROMETER ASSY
COVER(SHOWN IN THE OPEN POSITION)
ATTENUATOR ENT PNL
P/O HARNESS ASSY 0271-0348
P/O HARNESS ASSY 0271-0262
P/O HARNESS ASSY 0271-0360
P/O HARNESS ASSY 0271-0288
P/O HARNESS ASSY 0271-0252
P/O XFMR ASSY 0271-0253
P/O HARNESS ASSY 0271-0348
P/O HARNESS ASSY 0271-0348
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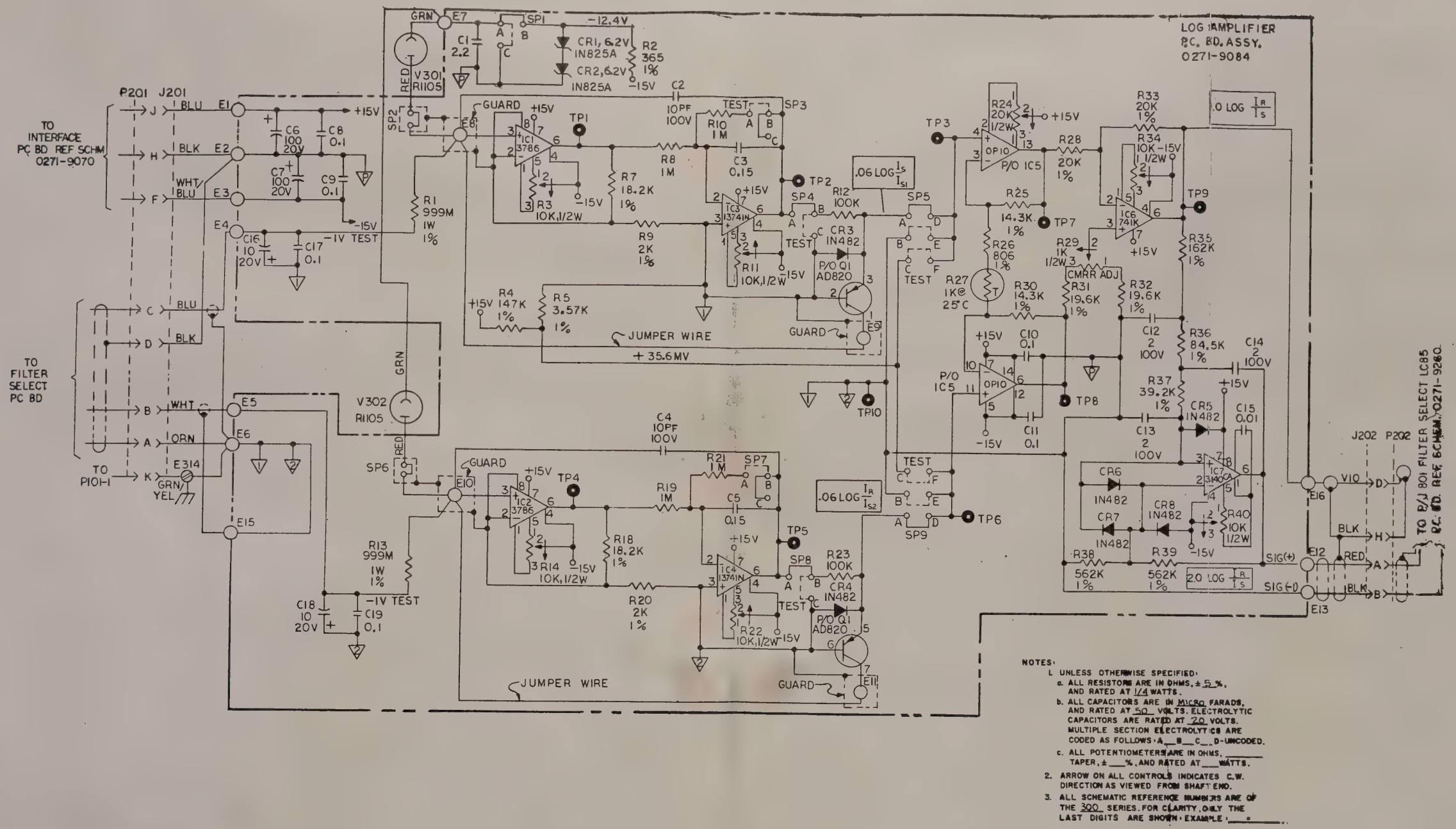
P/O HARNESS ASSY 0271-0348

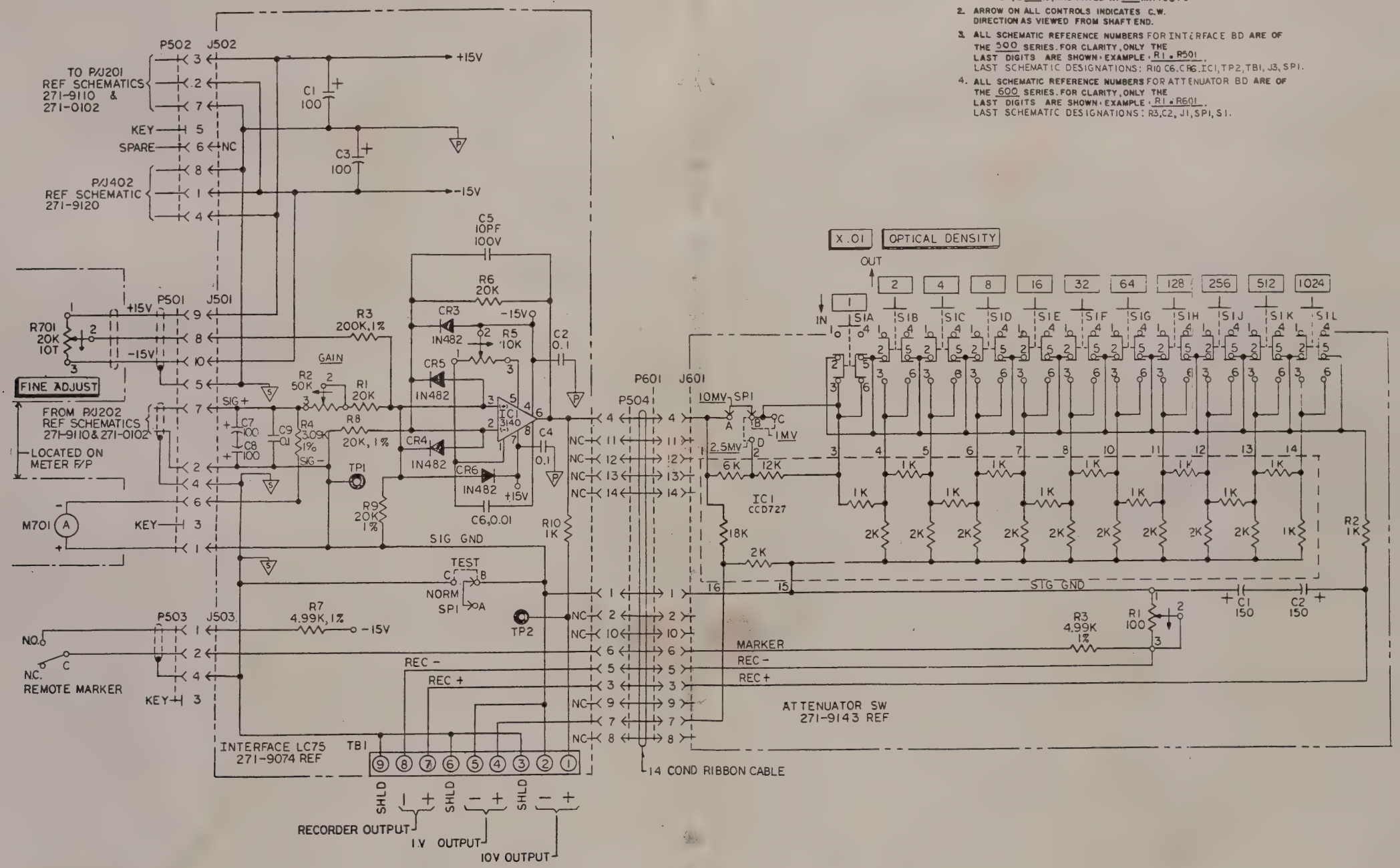


NOTES:

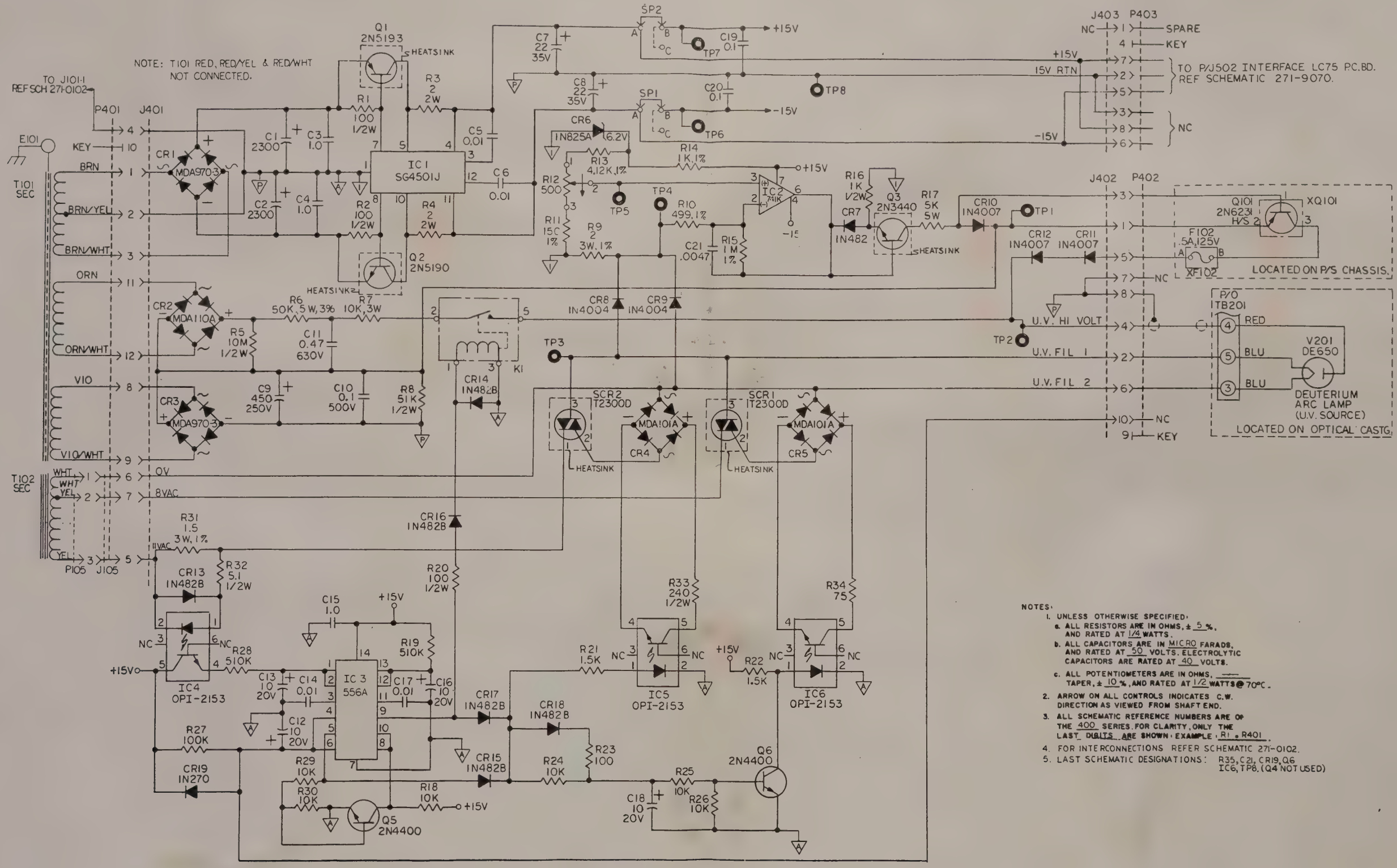
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS. MULTIPLE SECTION ELECTROLYTICS ARE CODED AS FOLLOWS: A__B__C__D-UNCODED.
   c. ALL POTENTIOMETERS ARE IN OHMS, _____ TAPER, ± ___ %, AND RATED AT ___ WATTS.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 300 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: ___.

Amplifier Schematic
0271-9080

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ═══ TAPER, ± 10 %, AND RATED AT 1/2 WATTS@70°
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS FOR INTERFACE BD ARE OF THE 500 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R501. LAST SCHEMATIC DESIGNATIONS: R10 C6. CR6. IC1, TP2, TB1, J3, SP1.
4. ALL SCHEMATIC REFERENCE NUMBERS FOR ATTENUATOR BD ARE OF THE 600 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R601. LAST SCHEMATIC DESIGNATIONS: R3, C2, J1, SP1, S1.



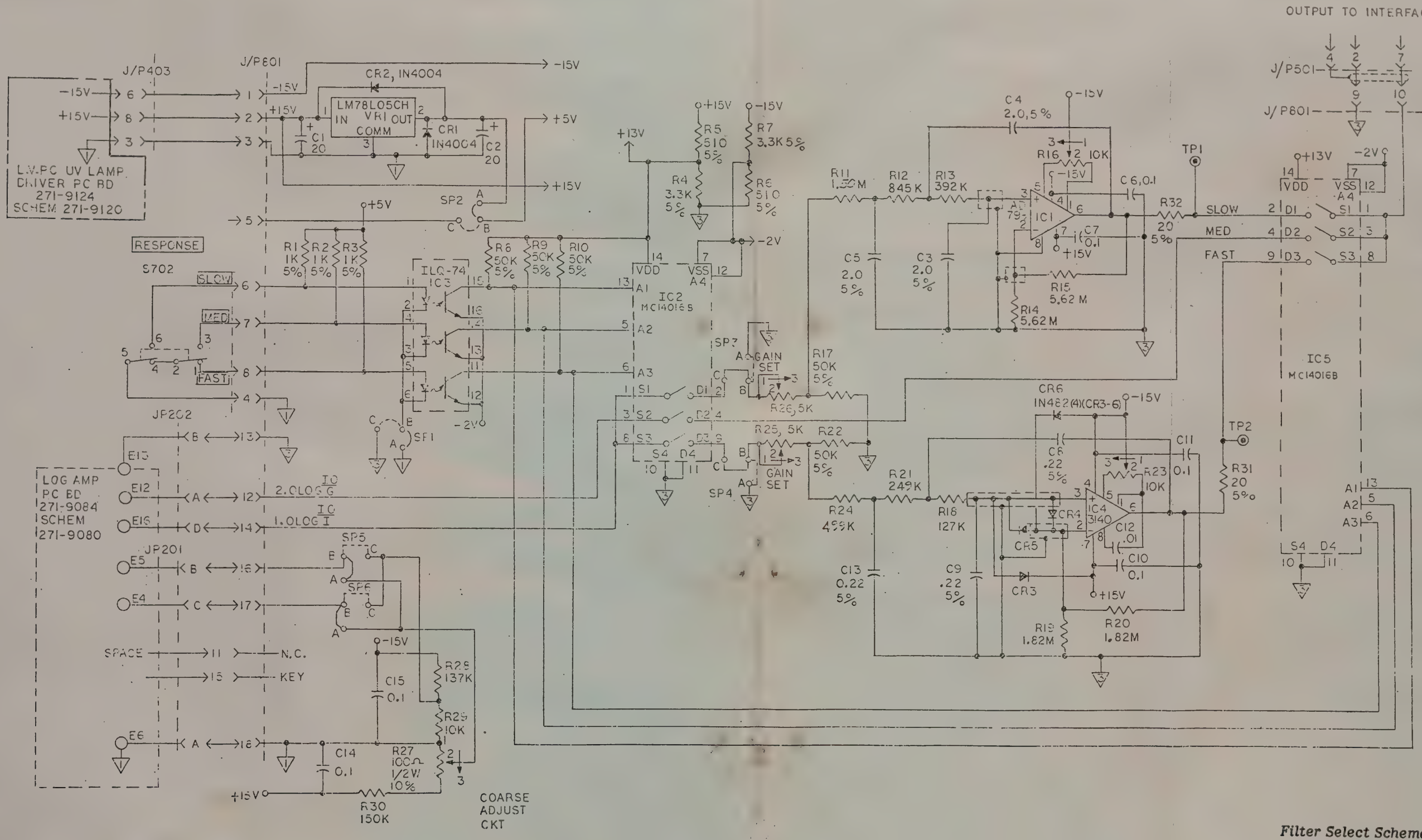
Interface Schematic
0271-9070



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 40 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ___ TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°C.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 400 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R401.
4. FOR INTERCONNECTIONS REFER SCHEMATIC 271-0102.
5. LAST SCHEMATIC DESIGNATIONS: R35, C21, CR19, Q6, IC6, TP8. (Q4 NOT USED)

Power Supply/Driver Schematic
0271-9120



Filter Select Schematic
(0271-9260, Rev. E)

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1 GENERAL INFORMATION

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1 GENERAL INFORMATION

1.1 GENERAL

1.1A The LC Autocontrol

The LC Autocontrol is designed for use with the Perkin-Elmer LC-75/85 spectrophotometric detector. The Autocontrol is bench-top mounted and the LC-75/85 detector is positioned above the Autocontrol as shown in Figure 1-1. The two units are connected via the electrical interface. The wavelength drive assembly is installed in the LC-75/85 detector at the time that the Autocontrol is installed except in those cases where the LC-75/85 and LC Autocontrol are provided at the same time, in which case, the wavelength drive assembly is shipped installed in the LC-75/85 detector. Installation of the wavelength drive assembly, contained in the LC-75/85 Upgrade Kit (0271-0311), and of the LC Autocontrol is performed by a Perkin-Elmer Service representative. The LC-75/85 Upgrade Kit is provided separately.

Figure 1-1 - LC Autocontrol with LC-85

The LC Autocontrol contains the electronics necessary to control the LC wavelength drive assembly as well as the means to program wavelength changes from the Autocontrol keyboard. A microprocessor-controlled background corrector is also incorporated in the Autocontrol.

2 INSTALLATION

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2 INSTALLATION

2.1 INTRODUCTION

The LC-75 or 85 Detector must be fitted with the LC Upgrade Kit (0271-0311). Instructions to upgrade the detector and install the LC Autocontrol are described in Instructions 0993-9577, provided with the LC Upgrade Kit, which is shipped with the LC Autocontrol 0271-0023 or 0271-0024. Kit 0271-0311 is factory-installed when the LC Autocontrol is shipped with 0271-0026, -0027, -0045, -0046, -0047, or 0271-0048.

2.2 ELECTRICAL CONNECTION

The components of the liquid chromatography system must share a common ground provided by a third wire in the electrical system. Do not tamper with the third prong on the line cord plug. The electrical supply must be capable of provided 100 VA at the nominal voltage and frequency of the instrument in use. Supplies should be clean and free of transient voltages. All electrical supplies must be within ±10% voltage tolerance of the nominal voltage of the particular instrument configuration and must remain within ±10% voltage tolerance. Instruments should not be attached to circuits associated with equipment of a heavy-duty nature (e.g., large motors) or large or frequent loads (e.g., photo-copying systems).

> Important: Make certain that the LC-75/85 Detector, LC Autocontrol, and Recorder(s) POWER switches are all OFF and that the AC line cords are removed from the respective AC outlets.

In general, the LC-75/85 Detector and LC Autocontrol are used in systems which utilize the following recording devices, whose uses are summarized in Table 2-1.

a. Two Controllable 10mV Recorders (P-E Model 056 or equivalent); see Section 2.2A.

b. One Controllable 10mV Recorder (as above) and the P-E Model Sigma 10 Console; see Section 2.2B.

c. One controllable 10mV Recorder (as above) and one 10mV Recorder which is not controllable; see Section 2.2C.

d. One 10mV Recorder which is not controllable and the P-E Model Sigma 10 Console; see Section 2.2D.

TABLE 2-1 - CONFIGURING THE RECORDER DEVICES

Case	a	b	c	d
Ref. Section	2E,1.	2E,2.	2E,3.	2E,4.
Device #1 (Records Chromatogram)	Model 056 Recorder*	Model 056 Recorder*	Model 056 Recorder*	P-E Sigma Console
Device #2 (Records Spectrum)	Model 056 Recorder*	P-E Sigma Console	Other Recorder**	Other Recorder**

*Or equivalent 10 mV recorder with provision for external control of the pen and chart drives.
**Any compatible 10 mV recorder without provision for external control of the pen and chart drives.

Wiring information for each of these cases is given below. In addition, the first case is illustrated in Figure 2-1. In each case the detector analog signal is obtained at TB1 in the LC-75/85 Detector and control (or interactive) connections from the Recorder and/or Console are made at the LC Autocontrol.

2.2A Connection of Two Controllable 10mV (Model 056) Recorders

1. Detector Analog Signal Connections

See Figure 2-1 and use one of the recorder signal cables (0271-0337), provided, to connect the chromatogram recorder to TB1 on the analog p.c.b. inside the LC-75/85 Detector in this manner:

Chromatogram Recorder (#1)	LC-75/85 Detector	Wire Color
High (+)	TB1-7 (RECORDER +)	RED
Low (-)	TB1-8 (RECORDER -)	BLK
Ground	no connection	Shield

Then jump the second recorder (used to record spectra) to the first using the second recorder signal cable (0271-0337), in this manner:

Chromatogram Recorder (#1)	Scan Recorder (#2)	Wire Color
High (+)	High (+)	RED
Low (-)	Low (-)	Blk
Ground	Ground	Shield

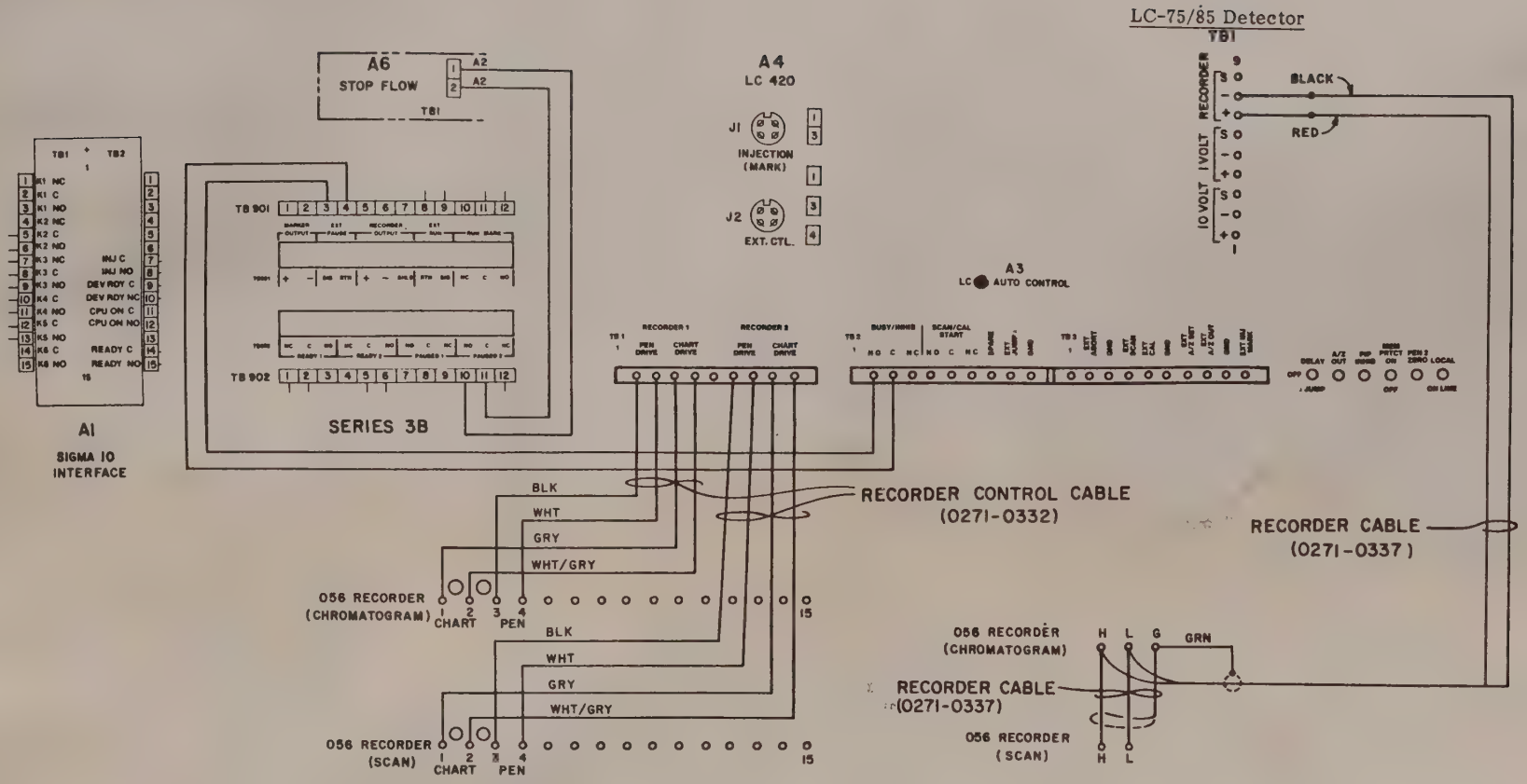

Figure 2-1 - Interconnection Diagram

Note: Alternatively, it is equally valid to wire the second recorder to TB1 at the LC-75/85 Detector analog p.c.b. using the connections given on the preceding page for recorder 1. The single recorder connection to the detector with subsequent interconnection of the recorders is recommended for its ease only.

2. Model 056 Recorder Control (start, stop) Connections at the LC Autocontrol

Important: These control connections pertain only to operation in the λ SCAN mode and the ABSorbance RATIO mode. When the LC Autocontrol is used in the BASELINE CORRECTion mode or the λ CHANGE mode, these connections must be disconnected. Prefereably, disconnect the recorder control cable at the LC Autocontrol.

Warning: Set the recorder POWER switch at OFF and unplug the recorder line cord before making any connections or disconnections at TB1 on a Model 056 Recorder.

Recorder for Chromatogram

Use one of the 4-conductor recorder control cables (0271-0332) to connect the LC Autocontrol to the recorder to be used for the chromatogram (typically, recorder #1) as follows:

LC Autocontrol	Model 056 Recorder	Wire Color
TB1-1	TB1-3	BLK
TB1-7(PEN DRIVE)	TB1-4	WHT
TB1-8	TB1-1	GRY
TB1-9(CHART DRIVE)	TB1-2	WHT/GRY

Recorder for Scan

Use the second 4-conductor recorder control cable (0271-0332) to connect the LC Autocontrol to the recorder to be used to record spectra (typically, recorder #2) as follows:

LC Autocontrol	Model 056 Recorder	Wire Color
TB1-6	TB1-3	BLK
TB1-7(PEN DRIVE)	TB1-4	WHT
TB1-8	TB1-1	GRY
TB1-9(CHART DRIVE)	TB1-2	WHT/GRY

When all the connections have been made, replace the recorder terminal strip covers and close the LC-75/85 Detector cover.

2.2B Connection of the P-E Sigma 10 Console and One Controllable Model 056 Recorder

Where the Console is used with a Model 056 Recorder, the Console is considered the recorder which records spectra and the Model 056 Recorder is used to record the chromatogram.

1. Detector Analog Signal Connections

   a) Model 056 Recorder (for chromatogram)

   Use one of the recorder signal cables (0271-0337) to connect the Model 056 Recorder to TB1 on the LC-75/85 Detector Analog p.c.b. in this manner:

Model 045 Recorder	LC-75/85 Detector	Wire Color
High (+)	TB1-7 (RECORDER +)	RED
Low (-)	TB1-8 (RECORDER -)	BLK
Ground	no connection	Shield

   b) Console (for spectra)

   Use the Console 2-conductor analog cable to make connection to the 10V terminals on the LC-75/85 Detector as follows:

LC-75/85 Detector	Wire Color
TB1-1 (10V +)	RED
RV1-2 (10V -)	ORG/BRN

2. Control Connections

   a) Model 056 Recorder (for chromatogram)

   Important: These control connections pertain only to operation in the λ SCAN mode and the ABSorbance RATIO mode. When the LC Autocontrol is used in the BASELINE CORRECTION Mode or the λ CHANGE mode, disconnect these connections. Preferably, disconnect the recorder control cable at the LC Autocontrol.

   Warning: Set the recorder POWER switch at OFF and unplug the recorder line cord before making any connections (or disconnections) at TB2 on a Model 056 Recorder.

Use one of the 4-conductor recorder control cables (0271-0332) to connect the Model 056 Recorder to the LC Autocontrol, making certain that the proper PEN DRIVE and CHART drive terminals are used:

LC Autocontrol	Model 056 Recorder	Wire Color
TB1-1	TB1-3	BLK
TB1-2(PEN DRIVE)	TB1-4	WHT
TB1-3	TB1-1	GRY
TB1-4(CHART DRIVE)	TB1-2	WHT/GRY

b) Console

Important: Never attempt to use the recorder #2 PEN DRIVE and CHART DRIVE terminals to control the Console. Rather use the SCAN/CAL START NO and C terminals (TB2-4 and TB2-5) on the LC Autocontrol to bring the external start signal to the Console interface. Make these connections as follows:

LC Autocontrol	Console Interface 3001	Console Integrator Junciton Box
TB2-4 (SCAN/CAL START NO)	TB2-8 (INJ NO)	TB1-8 (INJ NO)
TB2-5 (SCAN/CAL START C)	TB2-7 (INJ C)	TB1-6 (INJ C)

Note: Unlike the Model 056 Recorder control connections (above), these Console start connections need not be disconnected during operation in the BASELINE CORRECTION or λ CHANGE mode.

c) Console Timed Events

Depending upon the user requirements and the remaining system modules, the Console Timed Events may be used to initiate a wavelength change (in the λ JUMP sub-mode of the λ CHANGE Mode), abort a scan, start scan or calibration cycle, etc. Use the NO and C terminals of the Console timed events (generally, Console relays K4 through K6 will be sufficient) to make connection to any input terminals on the LC Autocontrol. (See Section 5B,2A)*.

2.2C Connection of One Controllable 10 mV (Model 056) Recorder and One 10 mV Recorder Which is not Controllable

Where only one of the two recorders used in the system can be controlled, the controllable Model 056 Recorder should be used for the chromatogram and the second recorder should be used to record spectra.

Make the detector analog connections as described in Section 2.2A,1 (above). Then refer to Section 2.2A,2 (above) and connect the single controllable recorder as either recorder #1 (to be used to record chromatograms) or a recorder #2 (to record spectra), depending upon the user's requirements. Recall that the recorder control connections must be disconnected whenever the LC Autocontrol is operated in either the BASELINE CORRECTion of the λ CHANGE mode.

*LC Autocontrol Instructions 0993-9550

2.2D. Connection of the P-E Sigma 10 Console and a 10 mV Recorder Which is not Controllable

In a system in which the Console is used with a 10 mV recorder, the Console is used to record the chromatogram and the recorder is used to record spectra.

Make the Detector analog signal connections as outlined in Section 2B,1, remembering that in this case, the Console will record the chromatogram. Then, refer to the Console discussion under Section 2B,2.

2.3 REMOTELY-CONTROLLED CYCLES AND FUNCTIONS

Three terminal blocks are located on the left side panel of the LC Autocontrol (see Figure 2-2). Relay contact closures, accessible at TB1, are utilized to control the pen and chart drives of two recorders (Perkin-Elmer Model 056 or equivalent). These recorders (customer-provided) are used to record separately the chromatogram and the scan. The analog signal to these recorders is obtained at the terminal block on the analog p.c.b., located in the LC-75/85 detector.

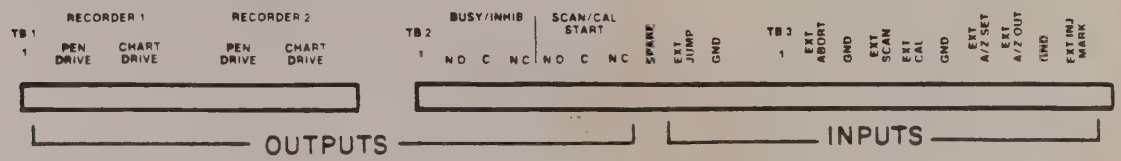

Figure 2-2 - LC Autocontrol TB1, TB2, and TB3

Relay contacts for the pen and chart drive are duplicated at TB2 (positions 1 through 6) and used as system status outputs to an integrator or data system, such as the Perkin-Elmer Model Sigma 10 Console. These outputs are labelled BUSY/INHIBit and SCAN/CAL START. Typical applications would utilize the first to send a busy signal to an integrator to prohibit data collection when the detector is not transmitting data (as during a calibration cycle) and the second, to send a ready signal to an external device. This ready occurs at the time that a SCAN or CAL begins.

The remaining two positions on TB2 and all of the positions on TB3 are inputs. The LC Autocontrol accepts external signals from other devices. These signals are used in an automated system, and as the terminal labels imply, duplicate the functions of certain LC Autocontrol front panel keys. One typical application, requiring the Perkin-Elmer Mothods Processor software, utilizes three of these:

EXT A/Z SET
EXT SCAN
EXT Wavelength JUMP

> **Note:** The last, EXTλJUMP and GND (TB2-7 and TB2-8), are unique in that these terminal positions accept an input signal in one mode only, the λ CHANGE Mode. In addition, a signal is sought and recognized only when the λ JUMP-DELAY-OFF switch, also on the LC Autocontrol, is placed in the λ JUMP position.

In the Methods Processor System, discussed in Instructions 0993-9535 provided with the software, one of the Series 3B READY signals is tied to the Autocontrol EXT A/Z SET terminals. The EXT SCAN and EXT Wavelength JUMP are each connected to one of the Console Timed Event relays. (In all cases the normally open contacts are used.) Other applications are possible and will depend upon the type of equipment in the system as well as the object of a specific system configuration. The Methods Processor Functional Wiring Diagram is given in Figure 2-3 for reference.

2.4 OPERATING SUMMARY

2.4A Single Wavelength Analysis (No Mode Operation)

Important: Do not place anything on the top surface of the detector. Also do not permit any solvent to leak into the detector interior.

1) Connect the system as required for the analysis and set up the detector as described in Section 2.2.

2) Place the Detector POWER switch at the ON (up) position. Allow approximately 30 minutes for the deuterium lamp to warm up. Turn ON the LC Autocontrol.

3) Read the analytical wavelength by pressing:

[λA]

and reading the stored value on the display (when the LC Autocontrol is POWERed ON the default value of 253.7 nm is stored for the analytical wavelength).

a) To accept the displayed (stored) value, press:

[RESET]

b. To change the displayed (stored) value, press:

[MODIFY]

Then type in the desired value for the analytical wavelength and then press:

[ENTER]

4) Use the Detector COARSE ZERO control to bring the energy meter to the green region. Then, simultaneously press these keys on the Autocontrol:

[A/Z] and [RESET]

5) The Detector attenuation (ABSORBANCE setting) required will depend on the type of recorder in use as well as the concentration of the components. Attenuate the signal as necessary to keep the peaks on scale.

6) Permit the system to equilibrate by running sufficient solvent through the column and detector until pure solvent flow is established. A flat starting baseline on the recorder is essential for repeatable analyses.

7) Inject the sample. (If a Rheodyne 7105 valve injector is in use, place the valve at the fill position before removing the plug. Then inject the sample, replace the plug and switch the valve to the inject position.)

2.4B Use of the ABSORBANCE$_{1cm}$ Range Selector

UV detection of a 1 μg sample of material with typical UV-absorbing properties will result in useful recorder data if the proper ABSORBANCE$_{1cm}$ switch is depressed. Initially, use a mid-range ABSORBANCE$_{1cm}$ setting (e.g., X16 = .16 A_{1cm}) to determine the sensitivity required. When a 10 mV recorder is used, an ABSORBANCE$_{1cm}$ setting of 1 results in 0.01 absorbance units (A_{1cm}) full scale. Eleven ABSORBANCE$_{1cm}$ switches are provided.

2.4C Use of Integrators and Data Systems

The use of the P-E Model Sigma Console or another data acquisition device is acceptable to the LC-75/85 detector.

Analog connection of the data acquisition device is made at TB1 on the Detector analog p.c.b. while interactive connections are made at TB1, TB2 and/or TB3 on the Autocontrol. Never use RECORDER terminals on the Detector or Autocontrol to make connection to a data acquisition device. (See Section 2.2.)

2,4D Zero Procedure

Two controls on the LC-75 are provided to zero calibrate the detector output and to adjust the recorder pen to baseline. These are the COARSE ZERO adjustment control and the Autocontrol Auto/Zero key. (Normally the Detector FINE ZERO is disabled.) The LC-85 has a FINE ZERO control only.

For the LC-75/85 proceed as follows:

a) Use the COARSE ZERO adjustment control to adjust the energy meter to within 3 divisions of zero (within the green region on the energy meter), on LC-75 model.

For the LC-85 proceed as follows:

b) Simultaneously press the Autocontrol A/Z and RESET keys to bring the recorder baseline to zero.

c) Repeat the procedure at each wavelength to be used for a given analysis. When working in the ABSorbance RATIO mode, be certain to monitor the detector baseline, adjusting the COARSES ZERO as required, at the lowest wavelength to be used.

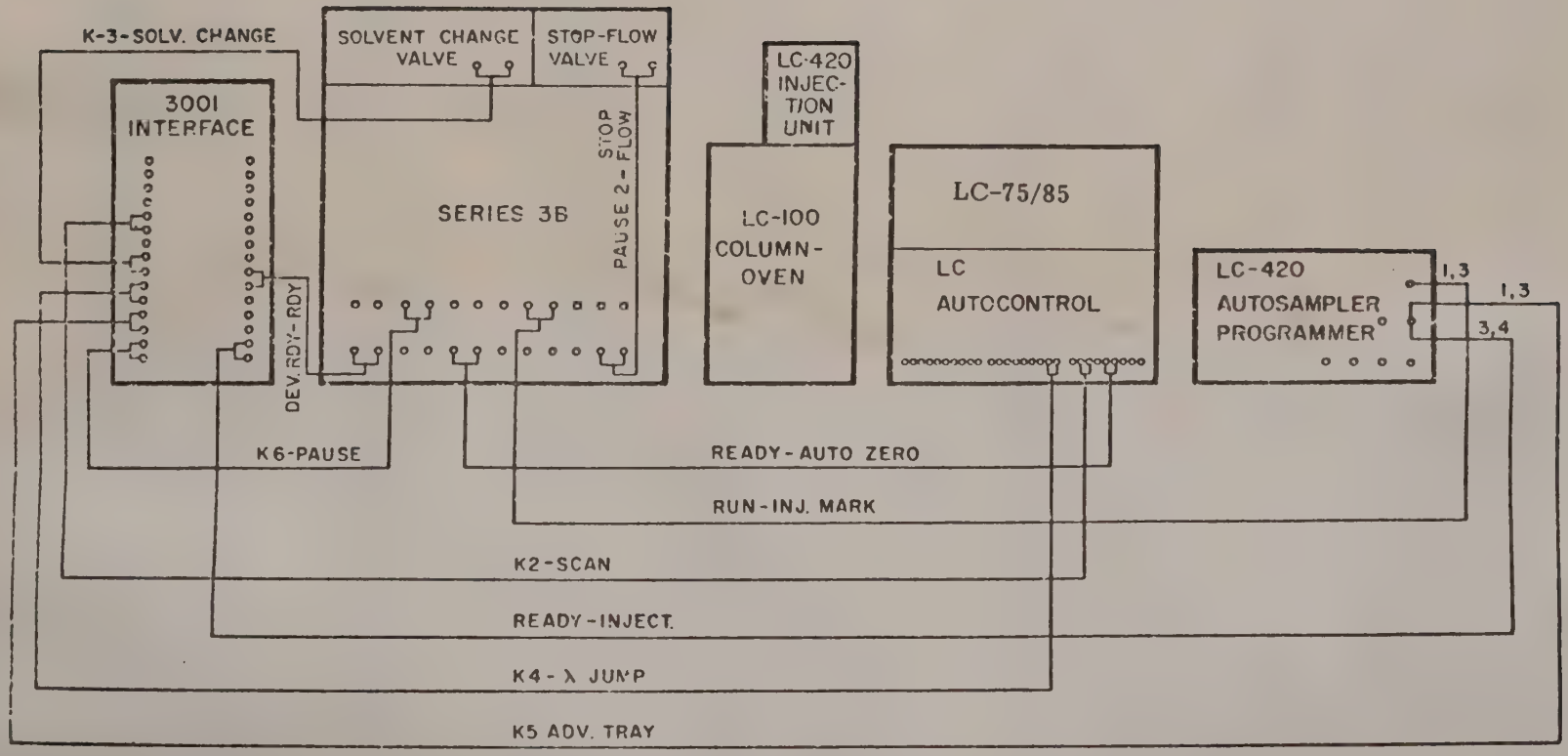

Figure 2-3 - Methods Processor Functional Wiring Diagram

d) If you are unable to zero the detector at a given wavelength, change either the analytical wavelength or the solvent. Monitor the detector output again and set the COARSE ZERO so that the energy meter needle deflection is kept as close as possible to the centerline of the meter over the range of wavelengths to be used. This is particularly important when working at multiple wavelengths.

2.4E Switching On

1) With the LC-75/85 Detector POWER ON, set the LC Autocontrol POWER switch ON. The LC Autocontrol drives the LC-75/85 to 253.7 nm and Autozeros the baseline.

2) If a mode will be used, simultaneously press RESET and the key representing the MODE (Wavelength SCAN, ABS. RATIO, BASELINE CORRECT, or Wavelength CHANGE) desired.

3) Allow 15 to 30 minutes warmup time.

4) Make sure lamp and flow cell have been adjsuted properly.

2.4F. Changing the Analytical Wavelength

> **Important:** The analytical wavelength cannot be changed during a CALibrate or SCAN cycle.

1) Press:

   [λA]

2) Press:

   [MODIFY]

3) Type in the desired analytical wavelength in nanometers (valid range is from 100.0 to 899.9) and then press:

   [ENTER]

   The LC Autocontrol drives the LC-75/85 monochromator to the new analytical wavelength via the benchmark (299.5 if the Detector UV/VIS switch is at UV; 6999.5 if the Detector UV/VIS switch is at VIS) and autozeroes the baseline.

2.4G. Rezeroing the Baseline

> **Important:** The Autozero is not functional during a CALibrate or SCAN cycle.

1) Simultaneously press:

[A/Z] and [RESET]

2.4H. Scanning Between Two Wavelengths (Wavelength SCAN MODE)

1) ENTER the Wavelength SCAN MODE by simultaneously pressing:

[λ SCAN] and [RESET]

2) Enter the starting wavelength by pressing:

[λ1]

[MODIFY]

Then type in the desired starting wavelength in nanometers (valid range is from 100.0 to 899.9) and then press:

[ENTER]

3) Enter the ending wavelength by pressing:

[λ2]

[MODIFY]

Then type in the desired ending wavelength in nanometers (valid range is from 100.0 to 899.9. $\lambda 2 - \lambda 1 \leq 200$) and then press:

[ENTER]

4) Make certain that the system is chromatographically stable before attempting to place the solvent background in memory by performing a CALibration cycle.

5) Set the Detector COARSE ZERO to place the energy meter needle as centered in the green region as possible while monitoring at λA.

6) If the chromatographic run is isocratic, stop the solvent flow at a convenient time after equilibration has occurred and begin the CALibration. If a gradient run is to be performed, perform the CALibration at the appropriate time (and therefore at the applicable percent strong solvent) when the peak is expected to elute. Begin the CALibration by simultaneously pressing:

[CAL] and [RESET]

7) Observe the LC-75 Autocontrol display and determine if the baseline approximates .000±.001 A_{1cm}. If values greater than this are observed, readjust the COARSE ZERO, monitoring at all wavelengths if necessary. Repeat the CALibration if the COARSE ZERO is readjusted. The ideal COARSE ZERO setting will result in approximately equal deflection above and below 0 on the energy meter during the CAL (and the subsequent SCAN).

8) Begin the SCAN at the time that the peak is in the cell by simultaneously pressing:

[SCAN] and [RESET]

Use the ABSORBANCE selector on the Detector to attenuate the detector analog signal to keep the recorder trace on-scale.

Note: Always perform a CALibration before each SCAN in the ABSorbance RATIO mode.

2.4I Obtaining Absorbance Values at Different Wavelengths (ABSorbance RATIO MODE)

1) Enter the ABSorbance RATIO MODE by simultaneously pressing:

[ABS RATIO] and [RESET]

2) Enter the value for the first wavelength at which the absorbance reading is to be taken by pressing:

[λ]

[1]

[MODIFY]

followed by typing in the wavelength in nanometers (valid range is from 100.0 to 899.9). Then press:

[ENTER]

3) Enter the value for the second wavelength at which the absorbance reading is to be taken by pressing:

[λ]

[2]

[MODIFY]

followed by typing in the wavelength in nanometers (valid range is from 100.0 to 899.9; $\lambda 2 > \lambda 1$). Then press:

[ENTER]

4) Continue in the same manner until subsequent wavelengths have been entered. If less than the maximum 9 readings are desired, enter 0 for $\lambda n+1$ when n defines the number of readings to be taken. In all cases, the valid range for entering the wavelength is from 100.0 to 899.9 nm and all wavelengths may be entered in any order but $\lambda n+1$ must be greater than λn.

5) Make certain that the system is chromatographically stable before attempting a CALibration.

6) While monitoring at the lowest wavelength to be used, set the Detector COARSE ZERO control to place the energy meter needle as close to centermost in the green region as possible.

7) Begin the CALibration by simultaneously pressing:

[CAL] and [RESET]

8) Watch the LC Autocontrol display to verify that the displayed values are .000±.001 A_{1cm}. If the displayed values exceed this range, readjust the COARSE ZERO and repeat the CALibration. The ideal COARSE ZERO setting will give approximately equal deflection above and below 0 during the CAL and SCAN.

9) To begin the ABSorbance RATIO SCAN, simultaneously press:

[SCAN] and [RESET]

Use the ABSORBANCE selector on the Detector to attenuate the detector analog signal to keep the recorder trace on scale.

10) Examine the stored values obtained at λ1 by pressing these keys in sequence:

[λ]

[1]

[ACTUAL VALUE]

after which pressing a number from 1 through 9 will in turn display the associated stored value obtained at the corresponding wavelength. For example, pressing (at this point):

[3] displays the absorbance measured during this SCAN at λ3

[2] displays the absorbance measured at λ2 etc.

When all the stored values have been displayed, press either:

[ACTUAL VALUE] or [RESET] to exit this display sequence.

2.4J To Correct for Gradient Background (BASELINE CORRECTion MODE)

Note: Synchronize the start of the CAL and SCAN with the RUN actuation of the Series 3B or gradient start on other systems.

1) Enter the BASELINE CORRECTion MODE by simultaneously pressing:

[BASELINE CORRECTion] and [RESET]

2) Enter the time in minutes after injection when the correction is to begin by pressing:

[T1]

[MODIFY]

followed by typing in the time in minutes (valid range for T1 is from 0.0 to 99.9). Then press:

[ENTER]

3) Enter the time in minutes after injection when the correction is to stop by pressing:

[T2]

[MODIFY]

followed by typing in the time in minutes (valid range is 0.1 to 99.9; T2-T1 ≤ 99.9). Then press:

[ENTER]

Note: The correction holds at the T2 value and stays in SCAN until reset to the starting value by simultaneously pressing:

[T1] and [RESET]

This provision is made to allow for late-eluting peaks.

4) To cause the varying solvent background to be placed in memory, simultaneously press:

[CAL] and [RESET]

Do not make a sample injection. Ignore the recorder output.

5) To begin the solvent program, make the sample injection and at the same instant, simultaneously press:

[SCAN] and [RESET]

The recorder output will be corrected for solvent variations.

2.4K. To Change Wavelengths (locally) with Respect to Time (Wavelength CHANGE MODE)

1) To enter the Wavelength CHANGE MODE, simultaneously press:

   [λ CHANGE] and [RESET]

2) To enter the first wavelength to which the monochromator should change (the chromatogram starts at the analytical wavelength then changes to λ1 after T1 has elapsed), press:

   [λ]

   [1]

   [MODIFY]

   and then type in the wavelength in nanometers (valid range is from 100.0 to 899.9). These wavelengths need not be entered in ascending order. Then press:

   [ENTER]

3) Enter the time at which this change is to occur by pressing (in order):

   [T]

   [1]

   [MODIFY]

   Type in the time in minutes (valid range is from 0.0 to 999.9) and then press:

   [ENTER]

4) Enter the second wavelength to which the monochromator should change by pressing:

   [λ]

   [2]

   [MODIFY]

   and then type in the wavelength in nanometers (valid range is from 100.0 to 899.9; λ2 cannot equal λ1.).Then press:

   [ENTER]

5) Enter the time at which this change is to occur by pressing:

[T]

[2]

[MODIFY]

Type in the time in minutes (valid range is from 0.0 to 999.9; T2 > T1). Then press:

[ENTER]

6) Continue in this manner until each wavelength change and time has been entered. In all cases, the valid range for wavelength entries is from 100.0 to 899.9 nm. Wavelength and time entries may be made in any order and Ti+1 must be greater than Ti. If less than the 9 maximum changes are required, enter 0 for λn+1 when λn defines the last wavelength change which occurs at Tn.

7) To terminate the program, enter the end time for Tn+1. For a 15-minute program with 4 wavelength changes, the last occuring at 10.5 minutes after sample injection, λ5 is set equal to 0 and T5 is set equal to 15. At 15 minutes, the program ends and the LC Autocontrol drives the monochromator to λA, the starting (analytical) wavelength. These two entries would be accomplished as follows:

To set λ5=0, press the following keys in sequence:

[λ]

[5]

[MODIFY]

[0]

[ENTER]

To enter 15 minutes for T5, press these keys in sequence:

[T]

[5]

[MODIFY]

[1]

[5]

[ENTER]

8) To locally begin the λ CHANGE SCAN, make the sample injection and at the same instant simultaneously press:

[SCAN] and [RESET]

2.4L. To Change Wavelengths (externally) Via Contact Closure (Wavelength Change Mode)

1) Enter the Wavelength CHANGE MODE by simultaneously pressing:

   [λ CHANGE] and [RESET]

2) To enter the first wavelength to which the monochromator should change (via contact closure across TB2-8 (EXT JUMP λ) and TB2-9 (GND) on the Autocontrol left side panel), press:

   [λ]

   [1]

   [MODIFY]

   and then type in the wavelength in nanometers (valid range is from 100.0 to 899.9). Then press:

   [ENTER]

   Note: In this submode of the Wavelength Change Mode, all the wavelength changes are keyboard-entered on the LC Autocontrol. As these wavelength changes are externally initiated via contact closure, no times are entered (contrast with Section 2.4K above). The External Wavelength Change Mode scan cycle begins when the λJUMP - OFF - DELAY switch on the LC Autocontrol is placed in the λ JUMP position and ends when this switch is placed in the OFF position. As long as this switch remains in the λ JUMP position and an external device signals the Autocontrol at TB2-8 and TB2-9, the system will cycle (and recycle indefinitely) through the wavelength changes.

3) Enter the second wavelength to which the monochromator should change by pressing:

   [λ]

   [2]

   [MODIFY]

   and then type in the wavelength in nanometers. (The valid range is from 100.0 to 899.9; entering λ2=λ1 is acceptable.) Then press:

   [ENTER]

4) Continue in this manner until each wavelength change has been entered. These wavelength entries need not be entered in ascending order. If less than nine (maximum) changes are required, enter 0 for λn+1 where n is the last change requested. For example, if 6 changes are necessary, enter 0 for λ7 by pressing these keys in sequence:

   [λ]

   [7]

[MODIFY]

[0]

[ENTER]

5) Set up the external device which will signal the wavelength changes. If using a timed device (e.g. a Console Timed Event relay), make certain that sufficient time is permitted for the slew, subsequent detector settling period (3 seconds), and the analysis. Rapid-fire wavelength changes (1/second) should not be commanded as alternate wavelength changes will be missed.

6) To begin the externally-controlled λ CHANGE SCAN, place the λ JUMP - OFF - DELAY switch in the λ JUMP positon.

> **Note:** Timing of the sample injection, the external device signalling and the chromatographic properties of the system (flow rate) and sample (retention time) must be carefully considered in determining when to switch to λ JUMP. The system remains at the analytical wavelength (λA) until the first wavelength change is commanded by a signal across TB2-8 and TB2-9 when the λ JUMP switch is at the λ JUMP position.

7) This submode of the Wavelength Change Mode is a non-terminating mode of operation. The externally-controlled Wavelength Change Mode is terminated by changing the λ JUMP switch to the OFF position.

2.4M. TERMINATING A RUN

1) Terminate a λ SCAN CALibration or SCAN cycle by simultaneously pressing:

[λA] and [RESET]

2) Terminate an ABSorbance RATIO CALibration or SCAN cycle by simultaneously pressing:

[λA] and [RESET]

3) Terminate a BASELINE CORRECTion CALibration or SCAN cycle by simultaneously pressing:

[T1] and [RESET]

4) Terminate a locally-controlled (internally-timed) Wavelength CHANGE SCAN cycle by simultaneously pressing:

[λA] and [RESET]

5) Terminate an externally-controlled Wavelength CHANGE SCAN cycle by:

switching the λ JUMP switch to OFF

3 THEORY OF OPERATION

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3 THEORY OF OPERATION

3.1 AUTOCONTROL THEORY OF OPERATION

3.1A. Instrument Description

The Autocontrol unit can be broken down into six different components. A block diagram is shown in Figure 3-1.

- Switching Power Supply
- Stepper Driver/PS Interface
- Benchmark Sensors
- Analog Board
- MPU Control with Keyboard and Display
- I/O Interface

1. Switching Power Supply

The switching power supply is used because of its light weight, size and efficiency while supplying regulated voltages with more than ample current capabilities.

2. The Stepper Driver/Power Supply Interface

The driver and interface serves three functions.

a) The MPU Board Stepper Driver signal is interfaced to the stepper motor that drives the LC-75/85 monochromator.

b) The Power Fail signal from the switching power supply is interfaced to the MPU to inform the MPU of a power fail or initial turn on condition.

c) Battery back up for the RAM's on the MPU board are located on this board and tied into the +5VSP bus line.

3. Benchmark Sensors

The sensors, which are mounted on the LC-75/85 monochromator wavelength counter, send signals to the MPU via the analog board to inform the MPU of the wavelength location.

4. Analog Board

The analog board converts the 6 mm pathlength signal of the LC-75/85 detector to a 10 mm pathlength signal which is the International Standard. This conversion in abasorbance is $1V/A_{1cm}$. The analog board also contains the analog correction circuits for the different operating modes and functions of the autocontrol system which are:

a) AutoZero
b) Background correct
c) Baseline correct
d) Signals for Displays

5. The MPU Board which uses an MC 6802 CPU chip as the heart of the unit is controlled by a user keyboard or by an external command through the I/O Interface board. When the user selects a mode of operation via the keyboard, the MPU identifies the command and sends command signals to the necessary components to perform the desired task.

6. I/O Interface

   The I/O Interface allows for control of the MPU to select a user desired function.

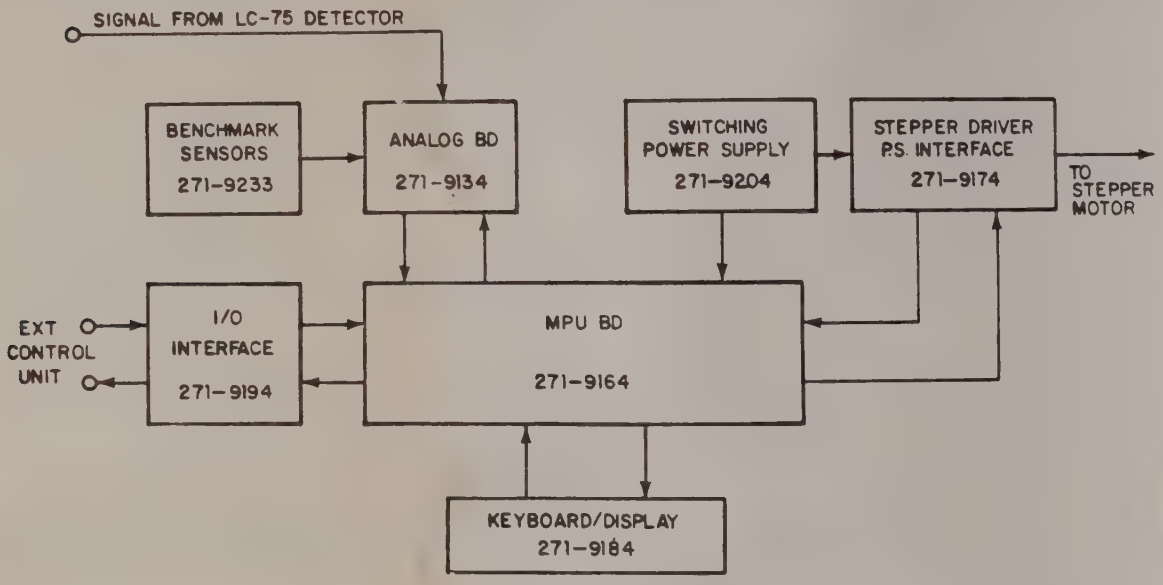


Figure 3-1 - Autocontrol Block Diagram

3.1B DRIVER SWITCHING POWER SUPPLY

1. Line voltage is applied to the RFI filter stage. The filter prevents switching noise from being reflected on to the AC line.

   The rectified DC is applied to the primary of T1; the primary return is through transistor Q4 to ground. The DC to DC converter is made up of transistors Q3, Q4 and Q5.

   The timer circuit A5 and associated components control the rate at which the switching transistors Q3, Q4 and Q5 turn on and off. The transistors, switching at a rate or 20 KHz, appear as an AC voltage at a 20 KHz rate.

The output of secondary taps on transformer T1 are +15V, 5VSP, and +5V. Because all of the output taps have a common return, it is necessary to protect only one line for regulation, the +5V line. Over voltage protection is accomplished by a Zener diode and a SCR that monitors the 5V line.

The under voltage circuit utilizes an amplifier and an optical coupler to sense an output voltage change.

The output of the optical coupler is applied to the timer circuit and depending on the conditon of the output change, either increases or decreases the speed of the timer switching rate. By increasing the switching rate, the output decreases.

2. Switching Power Supply Circuit Description (see Figure 3-2)
(0271-9204, 0271-0303)

Line voltage is applied across the full wave bridge consisting of CR1, CR2, CR3 and CR4. The filter capacitors C2 and C32 act as a voltage doubler to the primary of transformer T1.
The primary of T1 is the winding between pins 5 and 6. The windings between pin 2 and pin 3 and pin 1 and pin 4 supply the positive and negative bias for the switching transistor circuit.

The switching transistors (DC-to-DC converter) are Q3, Q4 and Q5. Transistor Q4 is in the return line for the transformer T1 primary pin 5. By turning Q4 on and off at a high rate (20 KHz), the rectified DC that is across the T1 primary winding of pin 6 and pin 5 is switched on and off acting like a 20 KHz AC voltage to the T1 primary.

The timer A5, applies a 20 KHz square wave to the base of Q3 and the base of Q5. When the output line from A5 is high, Q3 turns on. When the output line from A5 is low, Q5 turns on.

When Q3 turns on, the positive bias of approximately +10V is supplied to the collector of Q3, thru half wave rectifier CR9,and is applied to the base of Q4. Q4 turns on creating a current path to ground for transformer T1 primary pin 5.

When Q5 turns on, a negative bias of approximately -5V is applied to the collector of Q5 from transformer T1, pins 4 and 1, through half wave rectifier CR11. The negative bias is applied to the base of Q4 turning it off. The Darlington circuit for Q5 is used to increase the time in turning Q4 off.

The timer A5 sends a 20 KHz square wave at TTL level to the base of Q3 and Q5. The power for the timer is derived from the circuit of Q1 and Q2. The voltage divider R2 and R3 supplies approximately 6V to pin 8 of the timer A5.

The rate at which the timer operates is controlled by the threshold input (pin 6) and the trigger control (pin 2). The bias to these inputs is controlled by Q6. An increase in voltage to these inputs steps up the rate, while decreasing the voltage decreases the rate.

The secondary windings of transformer T1 form the primary winding. As discussed previously the voltage is switched at the rate of 20 KHz. The following is a description of the secondary taps.

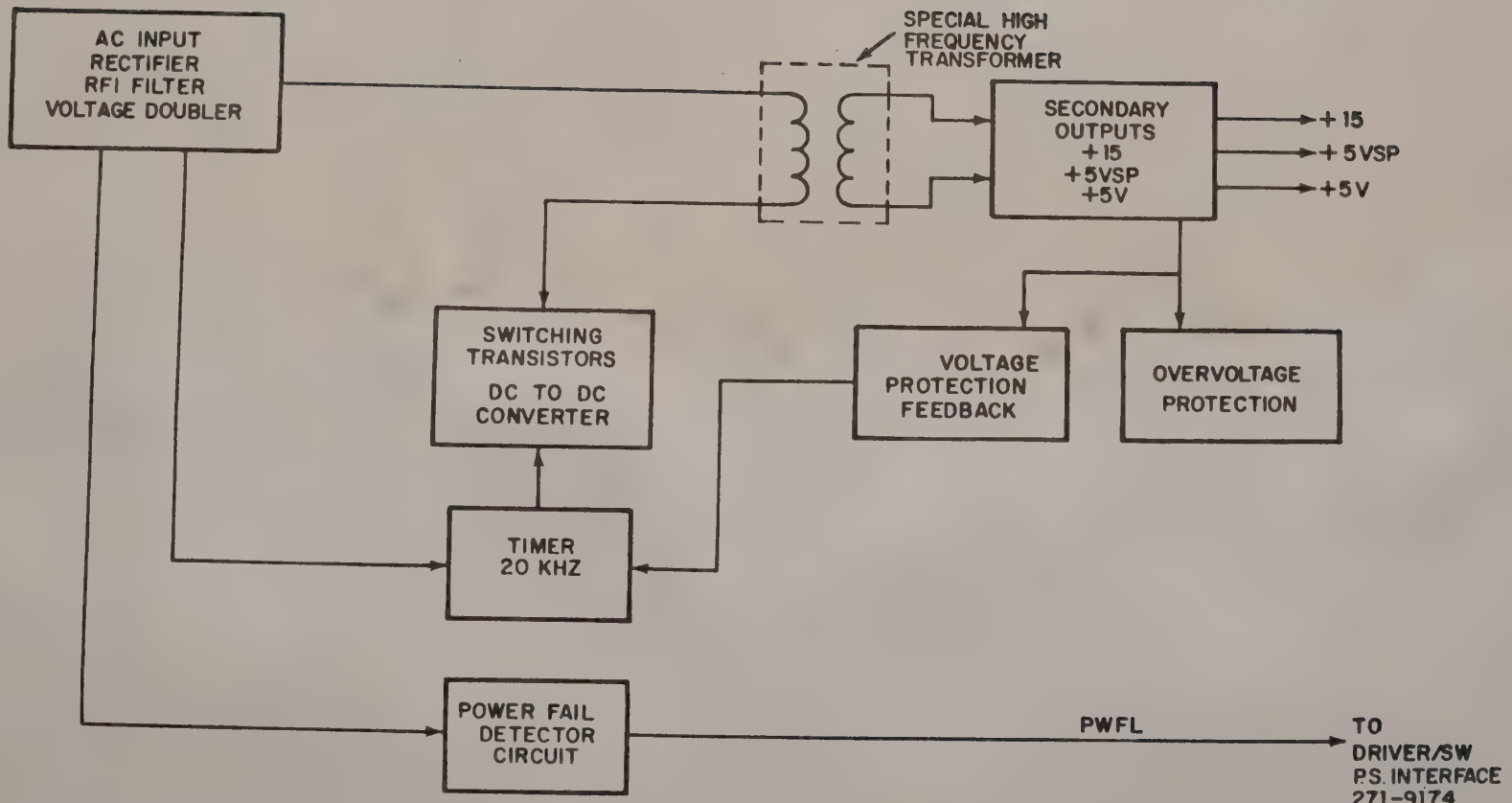


Figure 3-2 - Switching Power Supply Block Diagram

- Pin 12 is the +12V tap with CR21 being a rectifier
- Pin 9 is the +5V special tap with CR15 being the rectifier
- Pin 11 is the +5V tap (also taken from pin 9). CR 16 is the +5V rectifier
- Pin 10 is the common tap for all of the secondary windings. All of the input filters and load resistors are common to pin 10.

a. Overvoltage Protection

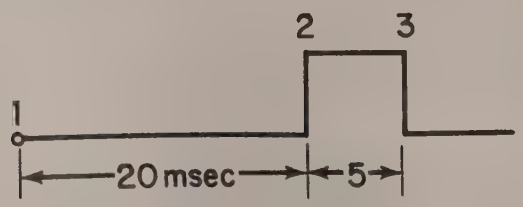
Overvoltage protection is provided by a "crowbar" circuit using Zener diode CR19 and SCR1. When the 5 volts exceeds the Zener breakdown voltage (+5V) it causes SCR1 to fire. When SCR1 fires, the voltage goes to ground. Because all of the secondary outputs have a common ground, they are all protected by the "crowbar" circuit. This is also true for the undervoltage sense feedback circuit. When the SCR fires and shorts to ground, the main instrument fuse blows.

b. Voltage Sense Feedback

The voltage sense feedback circuit monitors the 5V line. The 10K potentiometer, R35, is adjusted for +5±.01V. If the 5V line drops, the input to A2 decreases. When the input decreases, the output of A2 decreases further. The decrease in voltage, applied to the optical coupler A3, causes A3 to conduct less. The output of A3 is tied to the anode of CR14. The decrease in conduction of A3 puts a more positive potential on the base of Q6 thru CR14. Transistor Q6 conducts more allowing more of the positive potential to be felt on the collector. This more positive voltage is applied to pins 2 and 6 of A5 resulting in an increase in output frequency of A5. The increase in frequency results in higher output voltages on the secondary.

c. Power Fail Detect

Inputs E1 and E3 are connected across the 110V filter, C2. Potentiometer R2 is adjusted to a level that triggers A2 when the AC line drops below 105 VAC. When the line drops, the output (pin C) decreases. When the output of A2 decreases, the optical coupler conducts less causing the base of Q2 to go low (collector goes high). The collector of Q2 stays high for 5 msec before total power shutdown. The time before total power shutdown is 25 msec. See Figure 3-3.



1. *AC drops below 105 VAC*
2. *Q2 shuts off*
3. *Total power shut down*

Figure 3-3 - Power Fail Detect Timing

2. Driver/Switching Power Supply Interface Theory of Operation

The driver/switching power supply interface board serves 3 functions in the Autocontrol: battery back-up, stepper motor driver circuitry and power fail detector circuit. See Figure 3-4.

a. Battery Back-up - When the memory protect switch (on the I/O interface 0271-9194) is in the protect position, the batteries BT-1 thru BT-4 are enabled thru sense diode CR8 to the +5VSP line. The 5VSP line is the 5V source for the RAM's on MPU board 271-9164.

b. Stepper Motor Driver Circuit - The motor drive signal from the MPU board inputs to IC3. IC3 converts the +5V train to a +12V pulse train. The +12V train is fed to the stepper motor driver IC1. The sequencing of the outputs of IC1 is determined by the pulse rate at the input. The outputs are applied directly to the stepper motor windings.

c. Power Fail Detector Circuit - The power fail detector signal (generated on the switching power supply), utilizing comparator IC2, is interfaced to the MPU. The 2 signals PWRST and PWFL, are controlled by the state of comparator IC2.

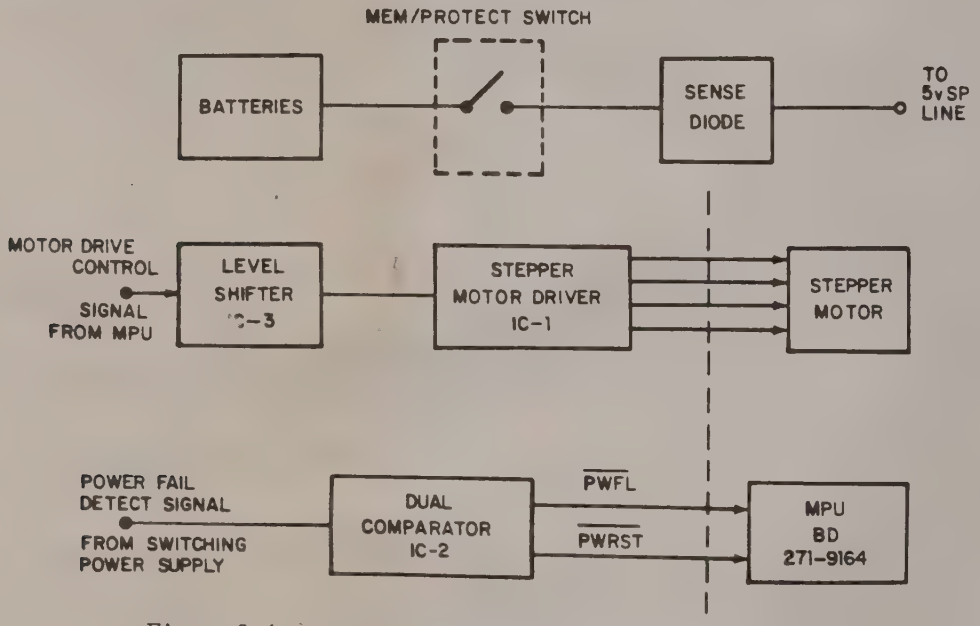


Figure 3-4 - Driver/Switching Power Supply Interface

3. Driver/Switching Power Supply Interface Circuit Description (0271-9174)

The motor drive signal inputs the board at IC3, pin 2. The 5V pulsing signal is converted to a +12V pulse by use of IC3, a low-to-high voltage level shifter. The 12V pulse (motor drive pulse) is fed to pin 25 of IC1 (stepper motor driver IC). Pin 15, the T input, is the controlling input for IC1. Pin 2, the T input, is held high for max/min noise immunity. Pin 3, the R input, controls motor direction. Pin 3 is high when the motor slews up in wavelength and low when the motor slews down in wavelength. The motor direction signal comes from the MPU board (thru IC3) to the R input.

R19 and C2, on IC1, are used to prevent the stepping sequence from being disturbed by transients in the 12V line. R1 thru R4 on IC1 inputs are +12V pull-up resistors.

The outputs of IC1, labeled Q1,Q2,Q3 and Q4, are connected directly to the motor windings and supply current to the motor windings that are controlled by the pulse train at the T input.

CR1 thru CR4, on the IC1 outputs, are snubber diodes. The diodes used to protect IC1 from inductance kick-back from the motor windings.

The Battery circuit, BT1 thru BT4, is for memory protect when there is a power shut down. This circuit is user controlled by S6 located on the Interface board. The Sense diode CR8, determines if the battery circuit is needed. If the +5VSP supplied by the switching supply shuts down and if the memory protect switch is in the on position, CR8 senses the loss of +5VSP and allows the 5V battery voltage to be applied to the +5VSP line.

a. Power On Condition - IC1 circuit is controlled by the Power Fail Detector circuit which is located on the switching power supply. The collector of Q2 (located on switching supply) is normally low on power-on and sets up the following conditions.

   The input of IC2B, pin 6 is low. Initially there is a low at pin 3 of IC2A. This low at IC2A, pin 3 goes high 1.0 second after initial turn on. This is controlled by R/C R8 and C1 and is supplied by the +5VSP line. This part of IC2A controls the Power On Reset signal. IC2 input pins 2 and 5 is a constant 2.5V that is created by divider network R20 and R15 and supplied by the +5VSP line.

   With IC2A, pin 3 initially low and pin 2 at 2.5V, the output at pin 1 is low, initially. This output goes high 1.0 second after initial turn on because of R/C R8 and C1. When input pin 3 goes high the output pin 2 follows. This high is fed to TP6 and then to the MPU board as the PWRST signal.

   The PWRST goes high 1.0 second after initial turn on to give the MPU time to set up to an operating condition.

   With IC2B, pin 6 at a low and pin 5 at 2.5V, the output pin 7 is high. This high at TP-7 is fed to the MPU board as the PWFL signal.

b. Power Fail Condition; or Power Off Condition - When there is a power fail, the collector of Q2 (located on the switching supply) pulses once with a +5V, 5msec wide pulse. This pulse (high) is felt at IC2B, pin 6 and sends IC2B otuput pin 7 low. This low is at TP7 and is fed to the MPU board as the PWFL signal. A low PWFL signal tells the MPU that the power is going down.

   When the PWFL signal goes low, CR7 which is tied to TP7 is turned on and provides a discharge path for C1. C1 is part of the R/C network that controls the PWRST signal.

   C-1 discharges thru CR7 and takes 3msec. This discharge puts a low at IC2A, pin 3 causing IC2A pin 2 to go low. The PWRST signal to the MPU board is now a low. Because the discharge time for C1 is 3msec and the PWFL pulse is 5msec the MPU has 2msec to react to the power failure.

c. Reset - A PWRST signal can be generated without a power failure by depressing the reset switch S1. Depressing S1 causes C1 to discharge thru the reset switch creating a low PWRST signal. This low to the MPU tells the MPU to react the same as a power off condition and resets the CPU.

3.1C. MPU Board Theory of Operation

The MPU contains the microprocessor chip that provides control of the detector, autocontrol, and where applicable, sums in the appropriate baseline or background correction to give a flat baseline on the analog outputs. The MPU board consists of 5 major componets.

1.	CPU	Central Processing Unit
2.	ROM's	Read Only Memories
3.	RAM's	Random Access Memories
4.	PIA's	Peripheral Interface Adapters
5.	GPIA	General Purpose Interface Adapters

The CPU is the heart of the MPU board and is capable of accepting, storing, providing a system clock, and arithmetically manipulating information. This information includes both data and controlling program. The CPU has 2 buses:

1. An eight bit bidirectional data bus that transports the data between the CPU and other components via their drivers.

2. A sixteen bit unidirectional bus that is used as the command lines when controlling the other components.

Power fail and power reset signals are supplied to the CPU from the driver/switching power supply interface board. The power fail signal is applied to the NMI (non-maskable interrupt not) input and warns the CPU of power failure. The CPU initiates a shut down routine sending all pertinent data to the scratch RAM's. Two milliseconds after the power failure the power reset signal is sent to the RESET input and shuts the CPU down.

There are four 4K x 8 ROM's which supply the CPU with necessary data to perform the autocontrol functions. These memories are for information purposes only, no other information can be stored in them by the CPU. The board has an additional socket for future memory expansion.

There are four 1K x 8 static RAM's. These RAM's are required to store: the background correction information during "CAL" over the various wavelengths; or the baseline correction information during "CAL" over the various times. All RAM's are protected by battery back-up to guard against temporary power outages. The five PIA devices provide interface between the CPU and I/O interface, keyboard, stepper motor, and analog board. An extra socket was put in for future expansion.

The GPIA and related hardware provide the means to interface between the IEEE-488 standard instrument bus and the CPU. The IEEE-488 bus provides a way for many instruments, connected in parrallel via a standardized 24 pin connector, to communicate with each other.

The GPIA and related components are not on the board.

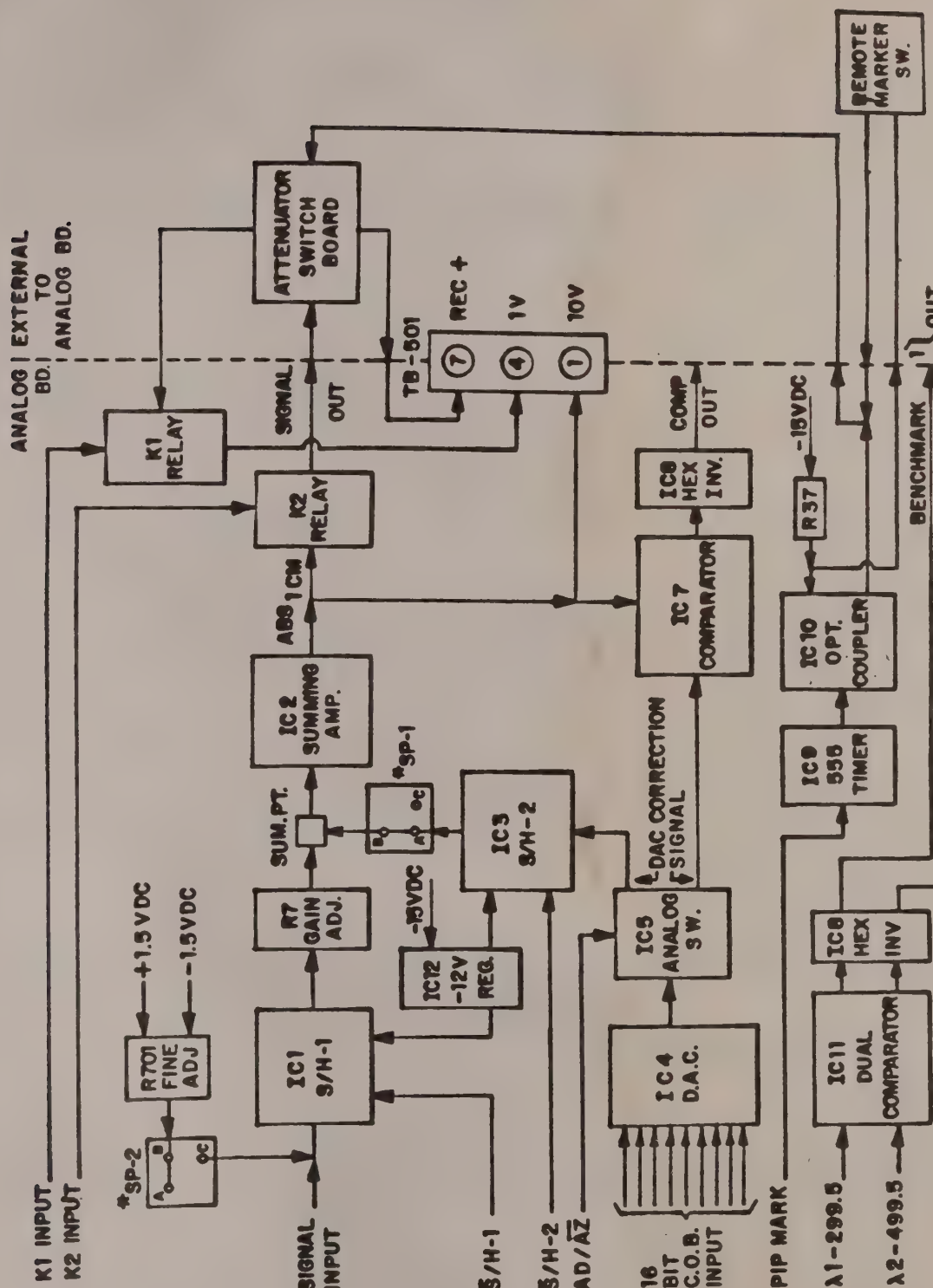


Figure 3-5 - Analog Board Block Diagram

3.1D. Analog Board Theory of Operation

1. Interface (See Block Diagram, Figure 3-5)

The sample cell in the LC-75/85 detector has a 6mm pathlength (the trend in LC is to have a 10mm pathlength). The pathlength is the length in millimeters that the source light (dueterium, D2, light) has to travel within the cell. See Figure 3-6.

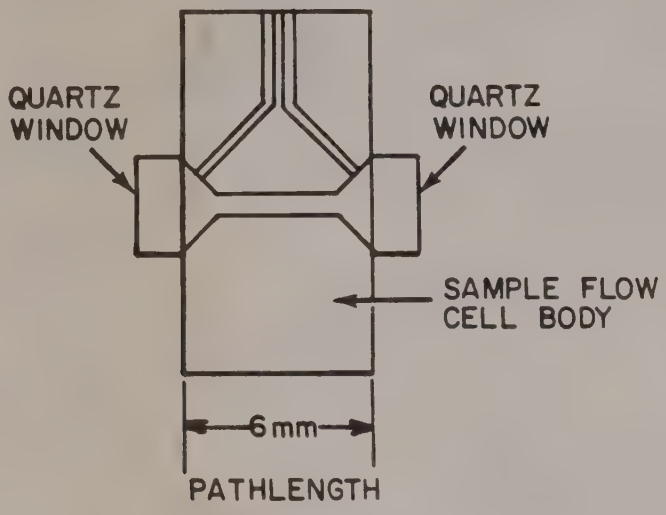


Figure 3-6 - Sample Flow Pathlength

An electrical means is utilized to convert a 6mm pathlength to 10mm.

The output of the log amp is:

$$e_o\ (V) = 2 \log I_o/I$$

This signal is standard when using a 10mm sample flow cell. However, when using a 6mm flow cell a gain reduction is required. The amount of reduction can be figured out as follows:

$$\frac{\text{Standard pathlength}}{\text{LC-75/85 pathlength}} = \frac{10\text{mm}}{6\text{mm}} = 1.666$$

The Log Amp. signal inputs the analog board via IC1, R7 and IC1 (See Figure 3-14). Adjusting R7 for zero ohms sets IC2 for unity gain or gain of 1. However, the actual gain of this circuit must be less than one to compensate for the conversion of

$$2 \text{ Log } I_o/I \text{ to } 1.666\ I_o/I$$

This means that the gain of IC2 must equal the output divided by the input or

$$\text{Gain} = \frac{\text{IC2 Output}}{\text{IC2 Input}} = \frac{1.666}{2} = 0.833$$

Adjusting R7 for an IC2 gain of 0.833 electrically, converts the LC-75/85 6mm flow cell to the International Standard of 1cm. This adjustment is covered in Section 6B Analog Board Alignment of the LC-75 Upgrade Instructions (0993-9577).

The Interface board's (271-9074) function is the same as the Analog board with the exception of the component numbering. The gain reduction is the same, 0.833.

2. Correction Circuits

The correction circuits perform many functions. Among these are:

a) Autozero
b) Background Correct
c) Baseline Correct
d) Signals for displays

Explaining the Autozero function first facilitates the explanation of the background and baseline corrections, and display signals.

3. Autozero

Depressing the Autozero and Reset keys simultaneously initiates the autozero routine. which is the zeroing out of the baseline (or IC2 output). This is accomplished by the DAC correction circuits IC3, IC4, IC5, IC7, IC8 and their associated components.

At the depression of the two keys, IC2 output is compared to the constantly changing DAC signal by means of IC7. The MPU sends a 16 bit digital word to the DAC. This word changes depending on the output of the comparator IC7 until a voltage level is selected, that when summed with the input signal, causes IC2 output to go to zero. The analog switch IC5 diverts the selected voltage level to the summing point of IC2 input via the sample/hold amp. IC3.

4. Background Correct

Depressing the λ SCAN (Mode 1) or ABS RATIO (Mode 2) and the RESET key set the Autocontrol for background correction. After selecting the Mode, depressing the CAL and RESET keys initiates the background correction (Mode 1).

MODE 1

The correction in this mode is from 1 to 2. Depressing CAL and RESET causes the stepper motor to slew. For every step of the motor, a 0.05 nm change in wavelength occurs and the detector output is digitized and stored into memory.

MODE 2

The correction in this mode can be anywhere from the first wavelength (λ1) up to 9 selectable wavelengths. Depressing CAL and RESET keys causes the stepper motor to fast slew to the first predetermined wavelength in memory. This wavelength is held for 3 seconds to allow the detector to settle, then the detector output is digitized and stored in memory before proceeding to the next wavelength.

The process for digitization is similar to the Autozero. The detector output (IC2 output) is compared to the constantly changing DAC signal by means of IC7. The MPU sends 16 bit digital words to the DAC. which changes depending on the IC7 output until the voltage level of IC2 output is determined.

Once determined, the MPU stores that digital word and repeats the process for:

MODE 1 - every step of the stepper motor
MODE 2 - every selected wavelength

Depressing the SCAN and RESET keys after CAL cycle is completed initiates:

MODE 1 - a wavelength scan routine between λ1 and λ2 values entered. The stored digital data is reconstructed and subtracted from the subsequent spectra to provide a flat baseline.

MODE 2 - an absorbance ratio routine among the wavelength values entered. The AutoControl subtracts the detector output obtained during CAL from the currently measured detector output for each wavelength stored in memory.

5. Baseline Correct

Depressing BASELINE CORRECT and RESET keys sets the AutoControl for baseline correction. After selecting the mode, depress the CAL and RESET keys to initiate baseline correction. The correction in this mode is from T1 to T2.

At the analytical wavelength desired, the AutoControl digitizes and stores the gradient baseline fluctutations at a predetermined time interval for a maximum 99.9 minutes interval during CAL cycle. Sampling rates for correction are 0.5 seconds for up to a 16 minute interval, 1 second for up to a 33 mintue interval, 2 seconds for up to a 66 minute interval and 3 seconds for up to 99.9 minute interval. Example, if the time between T1 and T2 is 24 mintues, the baseline is sampled, digitized and stored into memory every 1 second for 24 minutes.

The digitization process is the same as the background correct with the exception that the sampling is done in respect to time not to a change in wavelength.

Depressing the SCAN and RESET keys after the CAL cycle is completed initiates the scan routing between T1 and T2 values entered. The AutoControl reconstructs the baseline correction from the stored digital data and subtracts it from the current value to provide a flat baseline.

6. Display Signals

The analog board supplies the display with detector output signals. Depending on the mode selected or whether AutoZeroing determines when the analog signal is displayed. When the analog signal is displayed depends on mode selected or AutoZeroing.

In the Autozero process, the display goes blank for approximately 1 second until the process is finished. If the detector output is within the AutoZeroing limits, the display shows zero. If the detector output exceeds AutoZero limits the display shows the portion which exceeded the AutoZero limits.

After AutoZero, the detector output is constantly monitored and compared with the DAC correction signal until the voltage level is determined, then it is displayed on the front panel.

7. Benchmark

Benchmark is a point of reference which the MPU uses to determine the correct wavelength position. There are two benchmarks in the LC Autocontroller, one at 299.5 nm for UV and the other at 4.55 nm for VIS. The two benchmarks are selected by the UV/VIS toggle switch in the LC-75/85 Detector. The benchmark sensors are also located in the detector on the counter assembly.

Depending on the position of the UV/VIS switch determines which benchmark the MPU accepts. The benchmark signal is compared with a reference voltage by IC11 and signals the MPU that the benchmark has been reached.

8. PIP Mark

The PIP mark has two functions. First it serves to show the point of injection when the INJ MARK key is depressed. Second, to identify the wavelength while scanning, a PIP mark appears on every tenth unit, example -250-260-270-280-290.

The PIP mark is a pulse from the MPU to the timer IC9. which turns on IC10 and allows some portion of -15VDC to offset the REC OUTPUT and 1V OUTPUT.

3.1E. Analog Board Circuit Description (0271-9130)

The Analog Board replaces the interface board (0271-9074) when performing an LC-75 Upgrade (0271-0311). The Analog board provides the following:

1. Same function as the interface board
2. AutoZeroing
3. Digitization of baseline and background for correction
4. Signal levels for auto control display
5. PIP mark-external or internal
6. Benchmark sensing.

1. I.C. Descriptions

IC_1 and IC_2 (AD582KH) are sample hold (S/H) amplifiers. A low on pin 1 and the internal switch closed, allows the S/H amp to sample. A high on pin 1 opens the internal switch allowing C8 to remain charged to the last signal level it reached before the switch opened.

The S/H amp needs highly regulated -12 volts DC. Ths voltage is obtained by taking the regulated -15VDC and passing it through filter capacitors to a -12VDC regulator IC12 (LM-320 LZ-12).

IC5 (LF13333) is a Quad J FET Analog switch device with two normally closed switches and two normally open switches with disable. The input is designed to operate from minjmum TTL levels and switch operation also ensure a break-before-make action.

Pins 1,8,9 and 16 are tied together. A high at these pins energizes the switches (shown in de-energized state). In other words,the switch opens when energized if normally closed. Likewise, the switch closes when energized if normally open.

IC4 (DAC71COB0-V) is a 16 bit hybrid D/A converter which accepts Complementary Offset Binary (COB) digital input format. (See Figure 3-7)

PIN ASSIGNMENTS

I Models	Pin No	V Models
(MSB) Bit 1	1	Bit 1 (MSE
Bit 2	2	Bit 2
Bit 3	3	Bit 3
Bit 4	4	Bit 4
Bit 5	5	Bit 5
Bit 6	6	Bit 6
Bit 7	7	Bit 7
Bit 8	8	Bit 8
Bit 9	9	Bit 9
Bit 10	10	Bit 10
Bit 11	11	Bit 11
Bit 12	12	Bit 12
Bit 13	13	Bit 13
Bit 14	14	Bit 14
Bit 15	15	Bit 15
(LSB) Bit 16	16	Bit 16 (LSB
R_1	17	V_{out}
+5VDC	18	+5VDC
-15VDC	19	-15VDC
COMMON	20	COMMON
I_{out}	21	SUMMING JUNCTION
GAIN ADJUST	22	GAIN ADJUST
+15VDC	23	+15VDC
6.3V REF OUT	24	6.3V REF OUT

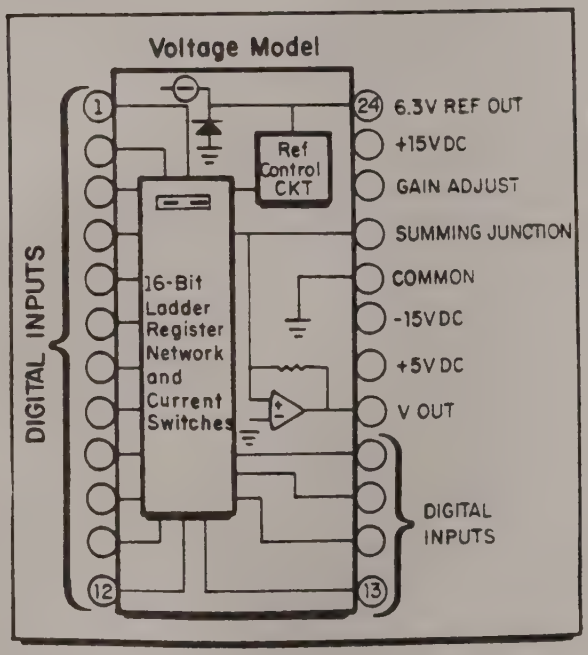


Figure 3-7 - IC4 (DAC71C0B-V)

2. Circuit Decriptions (Reference schematic 0271-9130)

a. Interface

The log electrometer amp signal enters the analog board at J501, pin 7(sig +) and pin 2 (sig -). This signal is monitored by the front panel meter M701 via R5 and is fed to IC1.

With SP1 in the A-B position, the input signal is nulled by using the Fine Adjust potentiometer on the front panel (as long as the panel meter needle is in the green region). With SP-2 in the A-C position, the Fine Adjust potentiometer is removed from the input signal circuit.

R6 provides an offset voltage while R1 and R21 (both 15K) establish a unity gain for IC1.

The output of IC1 is fed to IC2 via R7 and R12. With SP1 in the A-B position, a DAC correction signal can be summed with the input signal and fed to IC2. With SP1 in the A-C position, the DAC correction signal is removed from the input signal circuit.

R10 provides the offset voltage while R11 and R12 (both 11K) provide IC2 with unity gain, as long as R7 is adjusted for zero ohms. R7 sets the conversion from a 6mm pathlength flow cell to 10mm (Abs1cm). The adjustment of R7 is described in Section 3.2F of the LC-75 manual. The output of IC2 is fed to three places:

1) Attentuator board via K2 relay contacts. From here it splits the signal to two places: a) to the REC (+) terminal on TB501
   b) to the 1V terminal on TB501 via K1 relay contacts.
2) Direct to the 10V terminal on TB501
3) To IC7 Comparator Amp via R21

b. DAC Correction Signal

The MPU supplies the analog board with a 16 bit Complementary Offset Binary (COB) digital work with inputs on J505, pins 1 thru 16. The digital word is fed to the DAC (IC4) on pins 1 through 16. The DAC converts the 16 bit digital word to an anlaog voltage and outputs to pin 17 (TP7).

The DAC output is capable of varying as much as +10V to -10V. Since the capabilities of the autocontrol correction is ±3.277 Abs1cm, the gain and offset potentiometers were incorporated to keep TP7 voltage between ±3.277 volts. For proper adjustments of these potentiometers see Section 4.

For optimum performance and noise rejections C14, C15, and C24 all 1.0µf power supply decoupling capacitors. For best high frequency performance C7 and C11. 0.01µf capacitors are paralleled to C14 and C15.

R31 and R32 supply the feedback loop for the operational amplifier within the DAC. R30 and R33 provide the DAC Op. Amp with an offset voltage. (See Figure 3-8)

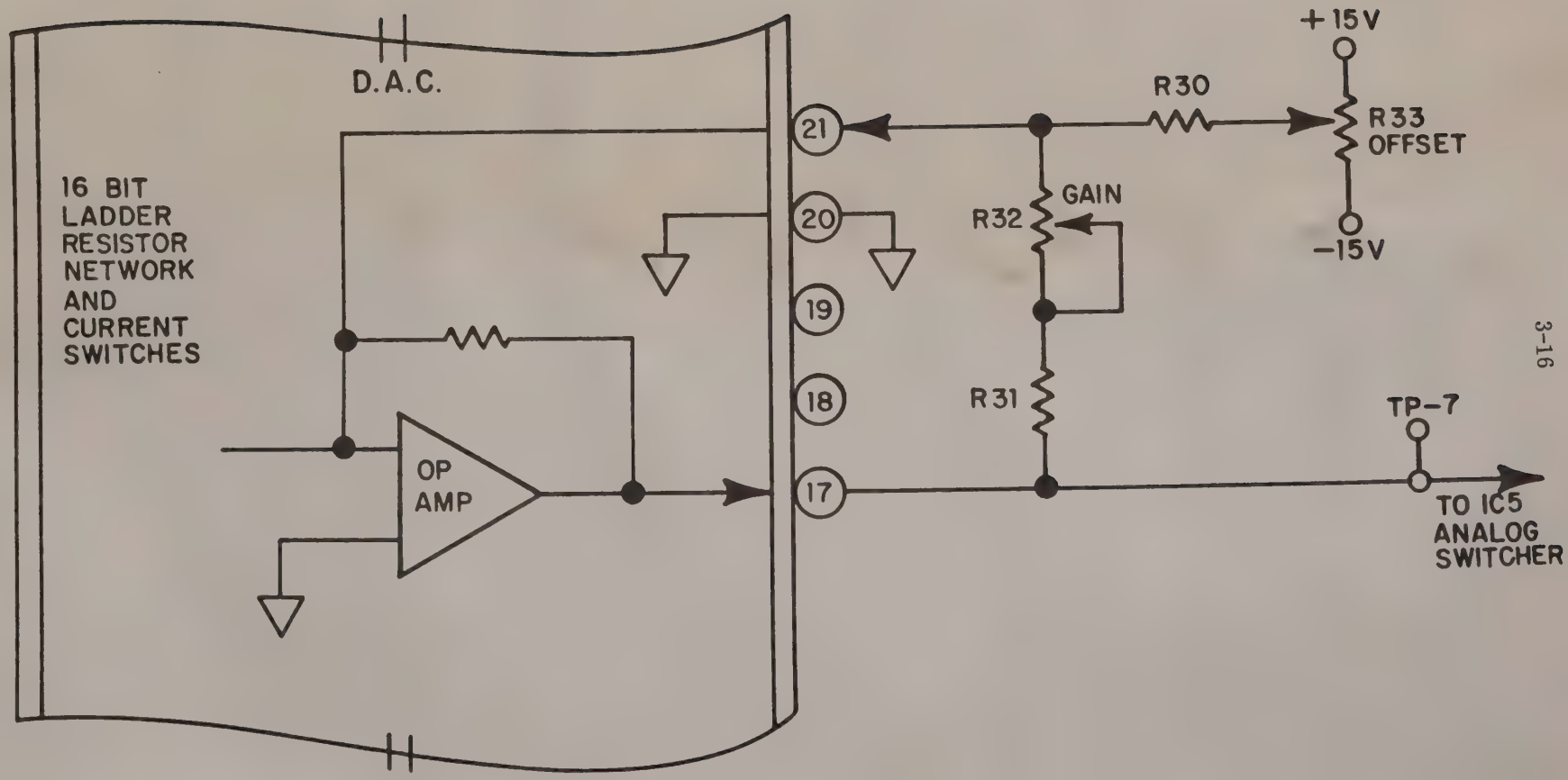


Figure 3-8 - DAC Correction Signal

The analog voltage of TP7 is the DAC correction signal and is fed to IC5 (analog switcher) on pin 3 and 14. Depending on what routine the MPU is on determines if the DAC correction signal outputs pin 2 (TP9) or pin 15 (TP11). If the signal outputs to TP9 then TP11 is grounded, also the reverse is true.

If the MPU is going to make a correction of the log amp signal (autozero, baseline or background correct) the DAC correction signal is fed to TP11. If the MPU is monitoring the log amp signal (TP4), the the DAC correction signal is fed to TP9.

The following is a discussion of the TP9 rate. The DAC correction signal leaves IC5, pin 2 and inputs IC7, pin 3. At IC7 the DAC signal is compared with the log amp signal at pin 2. The two input signal levels determine the output of IC7, which is compatible to TTL circuits. The TTL (IC7) output is fed to the inverter IC8 which in turn feeds the inverted TTL signal to the MPU. R26 and R29 are pull up resistors for IC8. R22 and R23 are used as the offset adjust for IC7. C20 and C21 filter the +15VDC and -15VDC respectfully.

The TP11 route is as follows. The DAC correction signal leaves IC5 pin 15 and inputs IC3 (a sampled hold amp) on pin 2. At this point the interval switch is closed and IC3 acts as a unity gain amplifier charging C12 to the input level and feeding the DAC correction signal to IC2, pin 2 via R9. At this point the DAC signal gets summed with the log amp. signal and accomplishes the following to the output of IC2:

1) If Autozeroing - The DAC signal nulls the log. amp. signal and IC2 output goes to zero.

2) If Baseline or Background Correcting - The DAC signal is subtracted from the log amp signal, which is now different due to the sample being in the flow cell; the difference is fed to IC2, pin 2 input. R15 is used as IC3 offset adjust. C13 filters the +15V supply to IC3.

c. PIP Mark - A 10μsec positive pulse inputs the analog board on J505, pin 19 when either the INJ key is depressed or every 10 nm on the tenth unit while scanning. This 10 μsec pulse is fed to pin 9, of IC8 an open collector output.

This provides a path for the voltage divider network of R38 and R34 to ground within IC8, placing some portion of the +5V on pin 2 (trigger) of IC9. A voltage on the trigger input puts a pulse on the output pin 3. The pulse width is 50 msec and is determined by the RC time constant of R35 and C23.

The pulse out of IC9 turns on the optical coupler IC10 for 50 msec which in turn provides a path for the -15VDC to go through R37 to pin 6 of IC10, out pin 4 and is fed to the attenuator board. The 50 msec offset voltage is fed to the REC to provide a pip mark on the recorder.

J503, pin 1 and 2 are used in conjunction within external switch or relay contact closure to produce the same effect as the pip mark circuit.

d. Relays - K1 and K2 energize when a positive high signal inputs the analog board on J505, pin 21 and 23. From the MPU, the positive signal is fed to IC8, pins 13 and 11 and causes the open collector of the two inverters which (IC8) to go to ground level

providing a current path from -5V through K1 and K2 relay coils to IC8 to ground. Once the relays energizes, the normally closed contacts open, disabling the log amp. signal (Abs1cm) from leaving the analog board for K2. K1 disables the 1V from leaving the analog board.

These signals are disabled, so that while slewing from one wavelength to another, the change in energy does not cause the recorder pens to overdrive into the stops.

e. Sensor/Benchmark - the sensors are not located on the analog board, but are needed to explain the benchmark circuit. TIL 139 emits infrared light toward the reflective ring located on the counter wheel. As long as the reflective ring is positioned to reflect the infrared light back to the optical coupler, the sensor within the optical coupler is turned on.

With the sensors turned on, a current path is formed. This path is from +5V through the collector-emitter of the sensors to J506, pin 7 for UV benchmark and pin 5 for VIS benchmark . The UV path continues to R45 then to ground putting approximately continues to R45 then to ground putting approximately +4.5 volts on pin 5 of IC11. The VIS path continues to R42 then to ground putting approximately +4.0 volts on pin 3 of IC11. R29 and R40 forms a voltage divider network putting 2.5 volts on pins 2 and 6 on the reference side of IC11 comparators.

At IC11, the sensor voltage is compared to the reference voltage and output to pin 1 and 7. R41 and R44 set up a very high gain for the two comparators whose outputs are TTL compatible.

When pin 5 is greater than 6 or pin 3 greater than 2, the outputs go to a TTL high level. When the two input pins are lower than the reference pins, the outputs go to a TTL low level. The two IC11 outputs get inverted by IC8 and are fed to the MPU as benchmarks 1 and 2.

The UV/VIS switch within the LC-75/85 Detector determines which benchmark the MPU accepts. The MPU can only accept one or the other.

If the counter is above 299.5 nm, while in the UV benchmark position, the motor always slews 4 nm below 299.5. This is to assure removal of backlash within the gears.

3.1F. Keyboard And Display Circuit Description (0271-9184)

The keyboard and display PC board consists of 3 parts: displays, keypad and keypad light circuitry.

1. Displays

The display IC's, IC1, IC2 and IC3 are controlled by the driver IC's, IC1 thru IC4 the decimal points and signs by buffer IC5. All of the commands to IC5 and drivers IC1 thru IC4 are supplied by PIA#3 on the MPU PC board.

2. Keypad

The keypad is the matrix type using rows and column lines to the MPU board. A depression of a keypad places a short on the row or a column. The MPU, via PIA#2 and PIA#5 continuously scans all rows and columns looking for a short. When a key is depressed, a short is identified at a certain row or column location that describes a certain function to the MPU.

3. Keyboard Lights

When a key is depressed on the keypad whether PIA#2 or PIA#5 (on the MPU board) identifies the location on the keypad matrix. The CPU recognizes the locations and sends a return signal through PIA#2 and PIA#5 to either IC6, IC7 or IC8 (4 line BDC to 10 line decimal decoder) on the keyboard. The decoder feeds the keyboard lamps that are located on the keypad. Depending on which key is pressed, the corresponding light illuminates. After the CPU recognizes that a key is pressed, it sends back a return signal that is decoded by the decoder that lights the proper lamp.

3.1G. Interface Board Circuit Description (0271-9194)

The interface is comprised of three areas: External Command Control, User Option Switches and Automatic Recorder Control.

1. External Command Control

All of the external control inputs on TB2 and TB3 feed IC1. A 10 line to 4 line priority encoder outputs to PIA#1 on the MPU board. A 10 line to 4 line priority encoder gives a BCD equivalent at the output depending on the input line selected. Priority is defined as the highest number selected, at the input, has control over the output.

2. User Option Switches

a) JUMP, OFF, DELAY, Switch - In the JUMP position, a low is sent to PIA#5 on the MPU as the JUMP signal.

In the OFF Position, the low signal floats. In the DELAY position, a +5V signal is sent to PIA#5. Placing the switch in the DELAY position activates a MPU programmed one mintue delay when pressing the SCAN or CAL keys to activate the λ calibration.

b) AZ OUT Switch - This switch is normally open, when momentarily depressed, it places a ground on pin 5 of IC1 and on the input of EXT. AZ Out.

When the AutoZero Out switch is depressed, the AutoZero offset is removed. The AutoZero Out function is inoperative during a CAL or Scan.

c) PIP Inhibit Switch - When placed in the PIP posiiton, a high is sent to PIA#5 as the MPU board TICK INHIBIT signal. In the PIP position, a marker occurs on the recorder every 10 nm

d) Local/On Line Switch - When this switch is in the ON LINE position, a high is sent to PIA#2 as LOC/ONLINE signal. This swtich is also used to disable the keyboard.

The ON LINE Position is used during external control.

e) Pen #2 Zero Switch - By placing this momentary switch in the REC #2 position, a low applied to relay K4, closes the contacts of the relay enabling recorder pen #2 to be zeroed. This circuit is normally disabled.

f) Memory Protect Switch - In the On position, this switch allows the battery voltage on the +5VSP line in the event of power failure. In the Off position, battery voltage is disabled at all times.

3. Automatic Recorder Control Circuit

The inputs from the MPU board, PIA#1 And/Or External, Scan/Cal Start feed inverter IC1. IC2 output is applied to the relay coils for K1 thru K4. Relay K1 controls recorder pin #1 and chart drive, relay K4 controls recorder pin #2 chart drive and relay K3 closure is used to indicate the mode of operation of the AutoControl to an external drive. All of the relay outputs are the result of relay closures. The input signals direct the relays to close during either scan or slew cycles. For detailed instruction or recorder hookup and operation, see Section 2 of Manual 0993-9550.

4 MAINTENANCE AND TROUBLESHOOTING

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4 MAINTENANCE AND TROUBLESHOOTING

4.1. ALIGNMENT PROCEDURES

4.1A. Detector

1) Switch ON the LC-75*detector to permit the deuterium lamp to warm up.

> **Caution**: Throughout the compliance tests, the upgrade installation, and the subsequent test and calibration procedures, it will be necessary to operate the LC-75 with the cover lifted. Observe caution to avoid electrical shock and wear UV-blocking glass safety glasses (e.g., Sellstrom No. C720 or equivalent) to protect the eyes from injury or damage.

2) With the flow through the cell stopped, disconnect the cell inlet line and place it in a beaker. Place the beaker at the same level as the solvent reservoirs (put the reservoir(s) on the bench) to minimize siphoning.

3) Remove the flow-through cell from the instrument. Remove the cell windows to isolate the effects of past chromatography from the true performance of the LC-75 detector. Blow out the cell inlet line, outlet line and the cell opening with clean, dry nitrogen (not oil pumped) to insure that a clean, dry, dummy cell results.

4) Inspect the cell windows and determine if cleaning or replacement is indicated. Do not re-install the windows in the cell until the entire modification has been completed.

5) Re-install the cell.

4.1B. LC-75 Check-Out Procedure

1) After a 30-minute warmup period, peak the lamp at 240 nm. Then peak the cell at 190 nm. Select a X1 attenuation setting on the ABSORBANCE switchbank on the LC-75. Set the wavelength control at 240 nm. Set the recorder SENSITIVITY at 10 mV, the chart speed at 5 mm/minute and center the baseline at 50% full scale on the recorder with the LC-75 FINE ZERO control. Verify that the drift does not exceed 20 divisions per hour. (It may be necessary to wait up to 4 hours.) The noise must not exceed 2 divisions total. Record the drift and noise obtained.

LC-75 Check-Out:

Noise = _____ divisions
Drift = _____ divisions per hour

*Where LC-75 Detector is designated it is understood to be LC-75/85 Detector.

2) Check the detector gain as follows. Select a X64 attenuation at the LC-75 ABSORBANCE switchbank. Verify that the wavelength control is still set at 240 nm. Set the LC-75 COARSE ZERO control 2 detents from fully counterclockwise. Use the LC-75 FINE ZERO to set the recorder baseline at the right-hand zero (equivalent to 100% full scale). (If recorder zero cannot be obtained, adjust COARSE ZERO accordingly.) Turn the LC-75 COARSE ZERO control 1 detent in the counterclockwise direction and record the number of divisions deflection.

3) Repeat step 2) above to verify the results. Expect between 50 and 90 divisions. If the gain is not within this range, the detector is out of absorbance calibration. Recalibrate the LC-75 and then repeat the gain check and record the results for future reference.

LC-75 Check-Out:

Gain = _____ # divisions deflection
COARSE ZERO set at _____ detents from full ccw.

4) Having verified that the LC-75 detector is performing within the specifications, switch OFF the LC-75 and the recorder. Remove all the line cords from the respective main power outlets.

4.1C. Analog PCB Installation Procedure

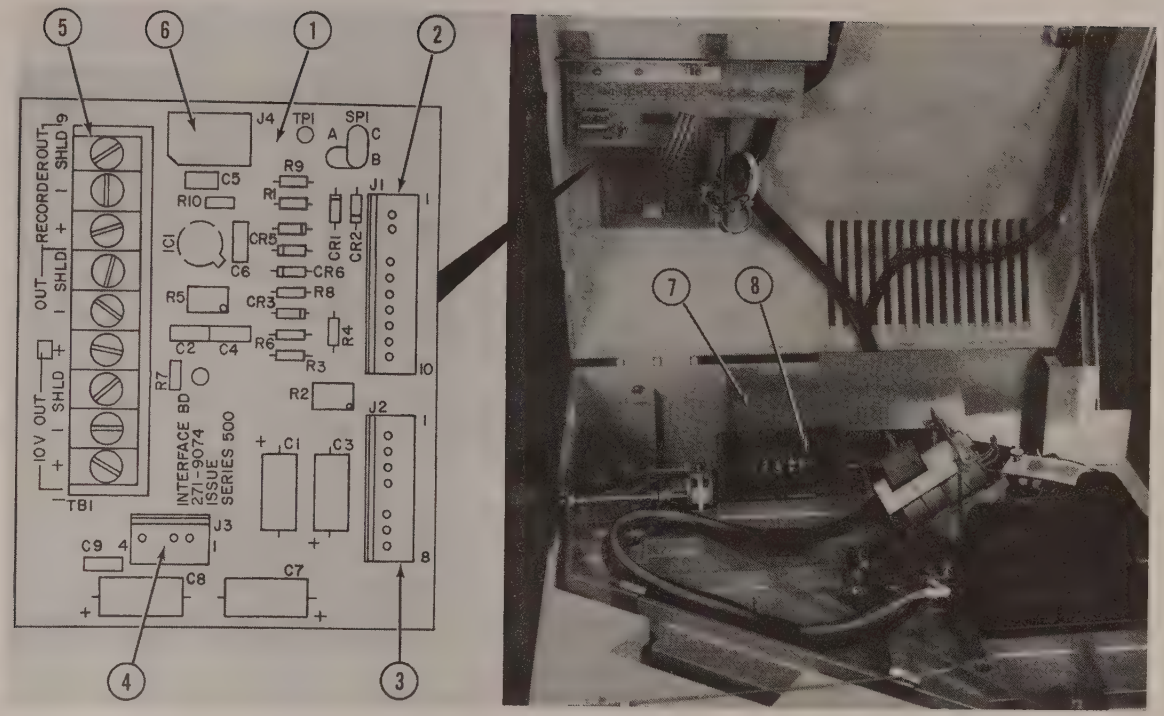
1) With the LC-75 POWER OFF and the recorder(s) OFF, make certain that the LC-75 detector and the recorder(s) are disconnected from line power.

2) Locate the interface p.c.b. (0271-9073) on the underside of the detector cover. (See Figure 4-1.) Disconnect the wires presently connected at TB1.

3) Disconnect the cables presently connected to J1 (10-pin), J2 (8-pin), and J4 (14-pin) on the Interface printed circuit board.

4) Remove the Ty-wrap and cable mount secured to the cover at the right of the Interface board to provide clearance for the slightly larger analog p.c.b. to be installed later.

5) Remove the four hardware sets which secure the interface p.c.b. to the cover. Remove the interface p.c.b. Save the mounting hardware.



1	*Interface P.C.B., 0271-9073*	5	*TB1*
2	*J1*	6	*J4*
3	*J2*	7	*Air Shield*
4	*J3*	8	*Bezel*

Figure 4-1 - LC-75 Interior View

6) Carefully remove the analog p.c.b. from its static-proof bag. Observe special handling procedures with this p.c.b. in order to prevent damage to the integrated circuits on this board.

7) Make certain that SP1 is in the NORMAL position (A-B) and that SP2 is in the A-C position. (Placing SP1 in the A-B position provides automatic background correction applied to the output of the LC-75 detector. Placing SP2 in the A-C position disables the FINE ZERO ADJUST on the LC-75 to eliminate possible sources of error which may be introduced by a change in the position of this control during a SCAN or CALibration routine.) Connect J4 to the 14-conductor ribbon cable from the attenuator p.c.b., folding the cable over the top of the connector.

8) Install the analog p.c.b. (0271-9134), provided with the LC-75 Upgrade Kit, in place of the interface p.c.b. using the hardware saved in step 5).

9) Identify the two protective bumpers (0990-8340), provided with the Upgrade Kit. Remove the backing from one bumper and position the bumper under the center of J1 on the analob p.c.b. so that 1/8-in. of the bumper will be visible. The bumper will stick to the top cover. Put the second bumper under the center of J2.

10) Reconnect the disconnected cables at J1 and J2 on the analog pcb.

11) Remove and discard the air shield.

12) Install the LC-75 cover plug (P-E Part No. 0271-1339) in the front "mouse hole" (previously used for the wavelength control shaft) in the left side of the cover.

4.2 TEST PROCEDURES

4.2A. Initial Checks

1) Make certain that the LC-75 Autocontrol 40-conductor cable is connected at the Autocontrol and at J5 on the analog p.c.b. in the LC-75 detector.

2) Verify that both recorder signal inputs are properly connected to TB1-7 and TB1-8 on the analog p.c.b. in the LC-75 detector. The shield on each cable (0271-0337) should be connected at each recorder in addition to HIGH and LOW.

3) Verify that the recorder control cables are connected to the LC-75 Autocontrol and that the LC-75 Autocontrol protective cover is in place on TB1.

4) Connect the AC line cords to the respective AC outlets, but do not switch ON any of the POWER switches.

5) Wear your safety glasses throughout the following procedures to protect your eyes from injury from the deuterium source which is exposed when the cover is open.

6) Switch ON the POWER to the LC-75 detector only; the deuterium lamp will light within 15 seconds.

7) Set the following switches on the LC-75 Autocontrol side panel:

   LOCAL/ONLINE at LOCAL
   PIP INHIBit at NOT INHIBit (down)
   DELAY/OFF/λ JUMP at OFF (center)
   MEMory PRoTecT at OFF

8) Set the UV/VIS switch on the LC-75 detector at UV.

9) Verify that the LC-75 Autocontrol POWER indicator is OFF.

   Note: In the following steps in this Section, watch the wavelength number counter. If it should go above 525 nm or below 190 nm, turn OFF the LC-75 Autocontrol immediately.

10) Switch ON the LC-75 Autocontrol POWER.

11) Observe that the LC-75 Autocontrol POWER indicator (incorporated in the POWER switch) illuminates.

12) Connect the wavelength drive knob (removed and saved previously) to the shaft being driven by the stepper motor. Use the coupling saved previously to connect the knob shaft to the motor shaft. Manually set the wavelength counter to 240 nm. Remove the wavelength knob and coupling.

13) Connect the DVM (-) side to TP1 on the analog board and connect the (+) side to the bottom of R44. Loosen the screw which holds the benchmark sensors on the sensor p.c.b. (0271-9233). Move the p.c.b. which contains these sensors up and down and rotate the p.c.b. to obtain a maximum voltage reading on the DVM. Retighten the screw. This reading should exceed +4.5 volts. If it does not, loosen the two screws which secure the benchmark sensor bracket and horizontally move the bracket to get a maximum voltage reading of greater than 4.5 volts.

14) Connect the DVM (+) side to R41. The DVM should read +4.0 volts (minimum). If it does not, reposition the benchmark sensor bracket as before, repeat step 13, and then reverify step 14).

15) Make certain that the benchmark sensor bracket screws are tightened.

16) Disconnect the DVM.

17) Connect the wavelength drive motor cable to J2 (WAVELENGTH DRIVE) on the LC-75 Autocontrol back panel.

18) Temporarily install the bezel on the wavelength counter with one screw.

19) Enter an analytical wavelength of 254 nm by pressing the following keys in succession:

[λA]

[MODIFY]

[2]

[5]

[4]

[ENTER]

The wavelength counter should slew toward 299.5 nm and then back to 254.0 nm. Check the accuracy of the reading and record the reading:

At 254 nm, WAVELENGTH Counter = _____ (nm)

The counter should read 254.0 ± 0.05 nm. If the counter reading is out of specification, reposition the sensor ring. Repeat step 19) until the counter reads 254.0 ± 0.05 nm.

20) Set the UV/VIS switch in the LC-75 detector at VIS.

21) Enter an analytical wavelength of 254 nm by pressing the following keys in sequence:

[λA]

[MODIFY]

[2]

[5]

[4]

[ENTER]

The wavelength counter should slew to 499.5 nm and then back to 254.0 nm. Check the accuracy of the wavelength counter reading. The reading should be 254.0 ± 0.1 nm.

At 254, WAVELENGTH Counter = _____ (nm)

22) Set the UV/VIS switch in the LC-75 detector at UV and repeat step 19) to verify that the UV condition still meets the specification (254.0 ± 0.05 nm reading on the WAVELENGTH counter).

23) Enter an analytical wavelength of 301 nm. Remove the bezel and apply a drop of Pliobond to both ends of the underside of the reflector ring. Secure the bezel.

24) Repeat step 22). It may be necessary to re-position the bezel.

25) Pull out the drawer on the LC-75 Autocontrol to expose the MPU board (0271-9164). Connect the DVM (+) lead to the (+) side of C3 and connect the (-) side of the DVM to the (-) side of C3. The DVM should read +5.000V ± .05V. If this reading is not within the specification, adjust R35 on the power supply board (0271-9204).

> **Caution:** When working in the area of the power supply, there are exposed components at high voltage levels.

26) Connect the DVM across C1 on the MPU board so that (+) of the DVM is connected to the (+) side of C1 and the DVM (-) is connected to the (-) of C1. The DVM should read +5.00 ± 0.25 V.

27) Connect the DVM (+) to (+) of C5 and the DVM (-) to (-) of C5. The DVM should read +12.00 V ± 1.2V.

28) Connect the DVM (+) lead to both sides of F1 on the Driver/Power Supply Interface p.c.b. (0271-9174). Leave the DVM (-) lead connected to the (-) side of C5 on the MPU board. The DVM should read 5.0 V ± 0.8 V on either side of F1. Disconnect the DVM.

4.2B. Analog Board Alignment

1) Disconnect the P2 connector located in the LC-75 detector. This is one of the two connectors located on the monochromator casting and has only one cable connected to it.

> **Note:** The following steps apply to the analog board (271-9134) in the LC-75 detector, unless otherwise stated.

2) Connect TP2 to TP8 by using a test jumper wire. Set jumper SP1 to the A-C position. and jumper SP2 to the A-C position.

3) Connect the DVM low side to TP1 and high side to TP3.

4) Adjust R6 until the DVM reads 0.0000 ± .0002 VDC.

5) Momentarily depress the A/Z OUT switch on Autocontrol left side panel.

6) Remove the DVM high side from TP3 and connect it to TP5.

7) Adjust R15 until the DVM reads 0.0000 ± .0002 VDC.

8) Remove the DVM high side from TP5 and connect it to TP4.

9) Adjust R10 until the DVM reads 0.0000 ± .0002 VDC.

10) Put SP2 in the A-B position, keeping SP1 in the A-C position.

11) Connect the DVM high side to TP3.

12) Using the FINE ZERO control on the LC-75, adjust for +1.0000 ± .0001 VDC on the DVM.

13) Connect the DVM high side to TP4.

14) Adjust R7 until the DVM reads -0.8333 ± .0002 VDC.

15) Put SP1 in the A-B position, keep SP2 in the A-B position.

16) Set the LC-75 Attenuation to X1, Recorder #1 Range to 10mV, chart speed at 5 mm/min, Power switch to SERVO, and Recorder Zero to midscale. Recorder polarity should be (-).

17) Simultaneously depress the A/Z and RESET keys on the LC-75 Autocontrol keyboard.

18) Recorder shall indicate zero ± 5 small divisions (0.0000 ± .0005 VDC). If this condition is not met, adjust R22 and repeat steps 17) and 18) until this condition is met.

19) Adjust R33 until the LC-75 Autocontrol keyboard display reads 0.000 ± .001 A_{1cm}.

20) Repeat steps 17) to 19) until the conditions of steps 18) and 19) are met.

21) Set the LC-75 Attenuation to X256. Depress the A/Z OUT on the side panel of the LC-75 Autocontrol. External DVM and keyboard display should read -0.833 ± .001. If not, adjust R32 until both agree.

22) Using the FINE ZERO control on the LC-75, adjust for +0.8333 ± .0002 VDC at TP4. External DVM and keyboard display should read +0.833 ± .001. If not, adjust R32 until both agree.

23) If R32 was not adjusted in step 22), continue. However, if R32 was adjusted in step 22), go to step 10) and proceed through step 23). Repeat until all the requirements are satisfied.

24) Disconnect the DVM and put SP2 in the A-C position. Verify that SP1 is still in the A-B position. Also remove the jumper from across TP2 and TP8.

25) Reconnect the P2 connector in the LC-75 detector.

4.2C. Gain Adjustment

1) Refer to Section 3A, step 3 to determine the detector gain prior to the modification. (The gain should have been between 50 and 90 divisions.) Record this value here.

DETECTOR GAIN BEFORE MODIFICATION: _____ divisions.

2) Select a X64 attenuation on the LC-75 ABSORBANCE switchbank. Verify that the analytical wavelength is set at 240 nm.

3) Turn the LC-75 COARSE ZERO control to fully counterclockwise and then set the COARSE ZERO control at 2 detents from the fully counterclockwise position or the COARSE ZERO setting used in step 2 (and recorded in step 3) of Section 3B.

4) Set SP2 on the LC-75 analog board at the A-B position.

5) Depress the A/Z OUT switch on the LC-75 Autocontrol left side panel.

6) Use the LC-75 FINE ZERO control for maximum energy (0.000 on the LC-75 Autocontrol display).

7) Rotate the COARSE ZERO control 1 detent in the counterclockwise direction so that control is 1 detent form the fully counterclockwise position.

8) Adjust R7 on the LC-75 analog board so that the detector gain agrees with the gain obtained before the modification (see duplicate record in step 1 of this section). Adjusting R7 in the clockwise direction decreases the gain while adjusting R7 in the counterclockwise direction increases the gain.

9) Having reset the detector gain to agree with the pre-modification gain setting, record the gain.

DETECTOR GAIN AFTER THE MODIFICATION: _____ divisions.

4.2D. Marker Adjustment

1) Set Recorder #1 chart speed at 80 mm/minute; verify that the Recorder #1 POWER switch is set at SERVO.

2) Select a X1024 attenuation on the LC-75 Detector ABSORBANCE switchbank. Enter an analytical wavelength by pressing the following keys in sequence:

[λA]

[MODIFY]

[2]

[4]

[0]

[ENTER]

3) Depress the INJection MARK key.

4) A spike of 10 small divisions should occur on Recorder #1. If it does not mark 10 divisions, adjust R1 on the LC-75 attenuator switch board until the pip mark is 10 divisions.

Note: On older instruments, R1 is accessible only from the left side of the attenuator switch board. Partial removal of the board from the instrument will be necessary to make required adjustments.

4.3 TROUBLESHOOTING

PROBLEM	CAUSE
1. No Power to Autocontrol	- Power supply has shut down - Line fuse or power supply fuse is blown - Power Supply board or Driver/Power Supply Interface board is faulty.
2. Indications are incorrect a) Successive indications on the same material is not reproducible.	- False chemical standard
b) Indications do not agree with previous determinations	- Change in chemicals or technique from previous runs - Laboratory environment contains UV-absorbing vapors - Wavelength range off
3. Scans toward zero (below 190) or toward 999 (above 600)	- Sensor Ring mounted incorrectly - Sensor Ring not reflecting - Benchmark sensors out of alignment - Defective benchmark sensor - Poor connection between sensors and Analog PC board (0271-9134) - Benchmark circuit on Analog board defective - Microprocessor board 0271-9164 defective
4. Autocontrol locked up on power on, does not go to READY state	- Power fail detector potentiometer (R2) on switching power supply set to high an AC voltage - Power supply voltages incorrect - Defective or disconnected cables - Defective keyboard (0271-9184) - Defective MPU board (0271-9164)
5. Instrument Fails Noise Specification	- Dirty Optics - Misaligned Optics - Defective or misaligned lamp - Defective or misaligned flow cell - Defective Analog Board - Defective Electrometer

PROBLEM	CAUSE
6. Memory Protect not functioning	- Switch in wrong position - Batteries dead - Defective RAMs on MPU
7. Keyboard commands not being accepted by MPU	- Poor connection between keyboard and MPU - Defective Keyboard - Defective PIA on MPU - Defective MPU
8. Scan Motor binding or not turning	- Couplings too tight - Cables defective or disconnected - Defective Power Supply Driver/Interface (0271-9174) - Defective motor
9. Wavelength Repeatability Failure	- Sensor Ring defective or improperly installed - Defective RAMs on MPU - Couplings too tight - Defective MPU
10. Instrument does not Autozero	- Poor connection between keyboard and MPU - Poor connection between Analog board and MPU - Analog Board jumpers in wrong position - Defective Analog Board - Defective MPU Board - Defective Keyboard
11. No Recorder Chart Drive response	- Improper connections on side panel - Defective cables - Defective I/O Interface Board (0271-9194) - Defective PIA No. 1 on MPU board - Defective MPU Board - Defective Recorder
12. External commands not controlling Autocontrol	- Improper connections at TB3 - Defective cables - Defective Interface Board (0271-9194) - Defective MPU Board (0271-9164)

4.4 MODIFICATIONS AND UPDATES

4.4A. Poor Ground Connections

Problem

C the LC Autocontroller, there is a possibility of two ground connections on the 271-9164 CPU board. If the problem is present there is a continuous baseline noise of approximately 3 divisions present on the chart recorder. Even if the noise is not present, the ground connections should be checked.

PURPOSE

To provide the service engineer with a quick test to determine if the problem is present and a quick fix to correct the problem if it has been identified.

MATERIALS REQUIRED

Ohm meter

PROCEDURE

1. Refer to the attached diagram and locate the two square pads on the 271-9164 CPU board.

2. Locate C38 and C40, (see Figure 4-2).

3. Measure the continuity from C38 and C40 to chassis ground. Use the power supply cage for chassis ground.

4. If there is good continuity the problem is not present and there is not need to continue with this procedure. If there is poor continuity, continue on.

5. Remove the CPU board (271-9164) from the Autocontroller chassis.

6. Identify the stand-offs that are located on the Autocontroller chassis, which are directly under the two square pads on the CPU board when the CPU board is installed.

7. Either file or scrape the top of the stand-off so that they will make a good electrical connection with the square pads on the CPU board when it is installed. Be sure to check the square pads on the CPU board (top and bottom) to be sure they are free of solder masking material.

8. Reinstall the CPU board into the Autocontroller chassis.

9. Recheck the continuity from C38 and C40 to chassis ground.

10. Procedure is complete.

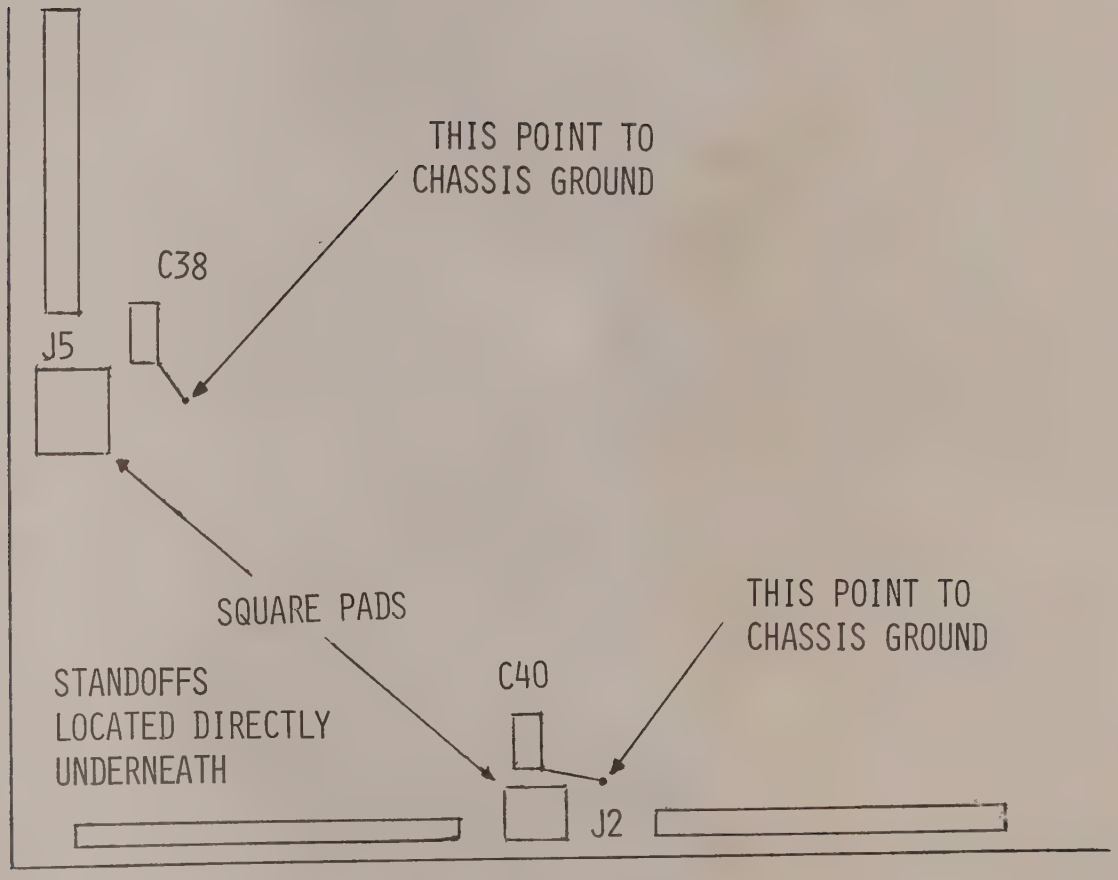


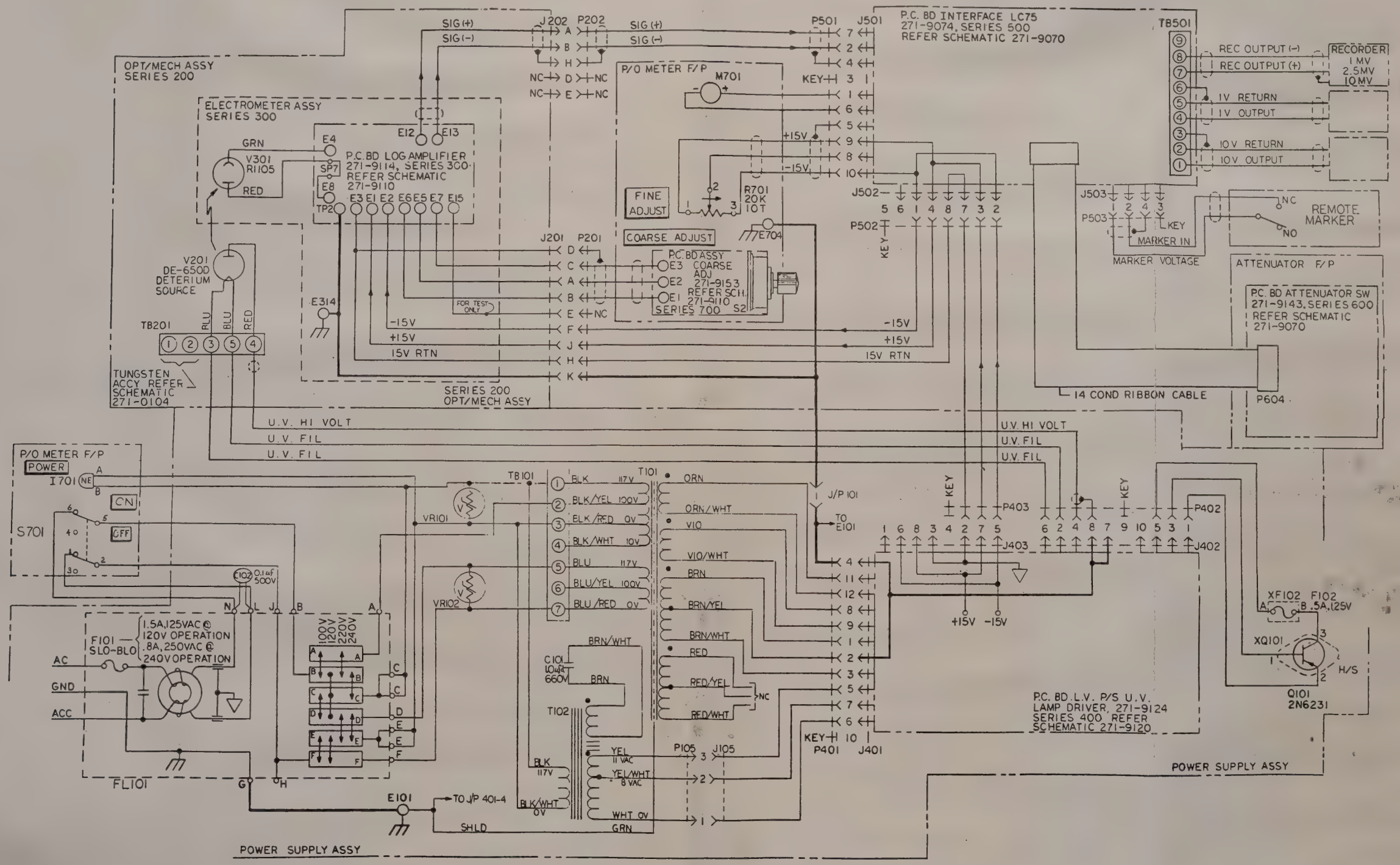
Figure 4-2 - 0271-9164 CPU Board

5 SCHEMATICS

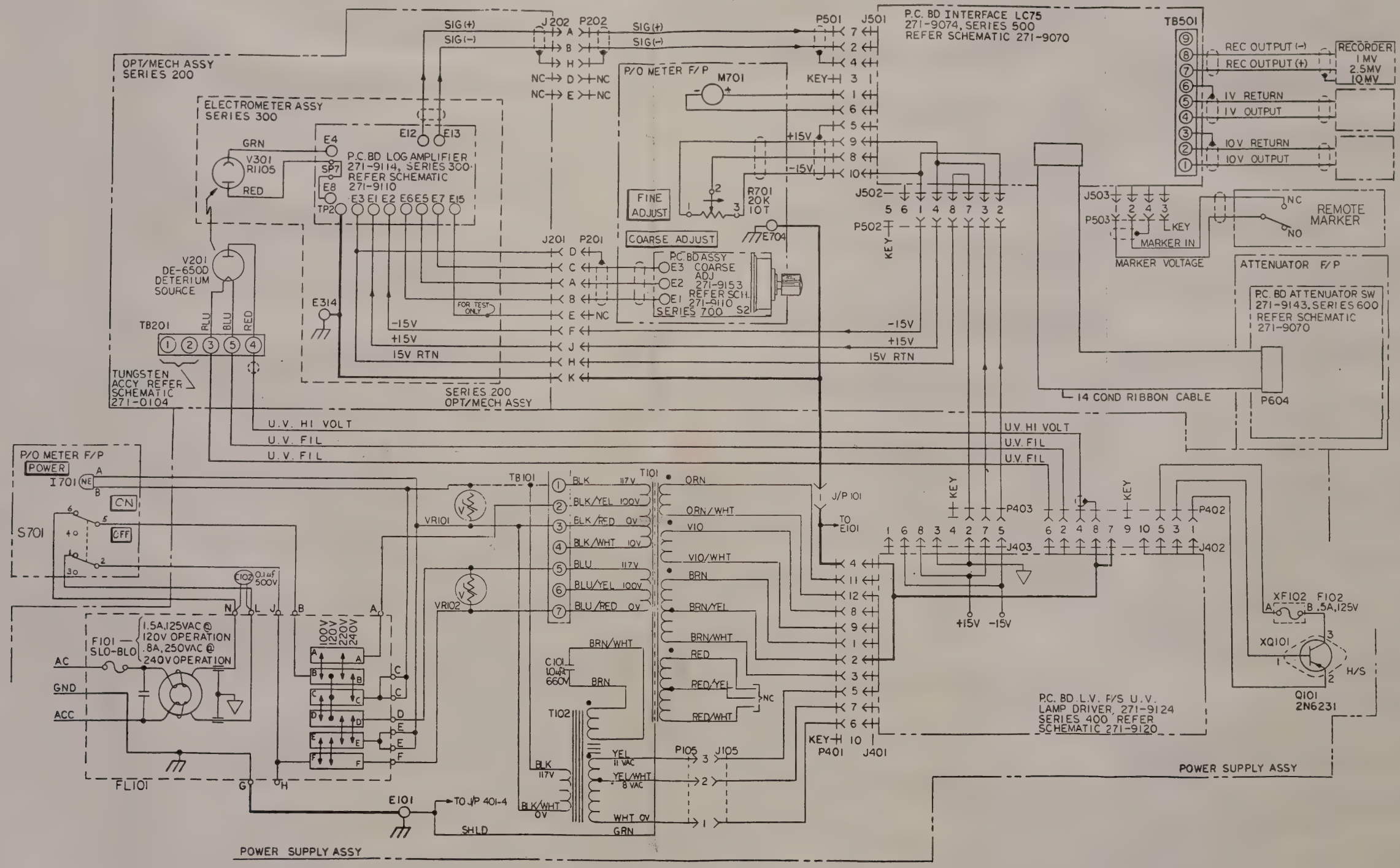
5 SCHEMATICS

5.1 DESCRIPTION

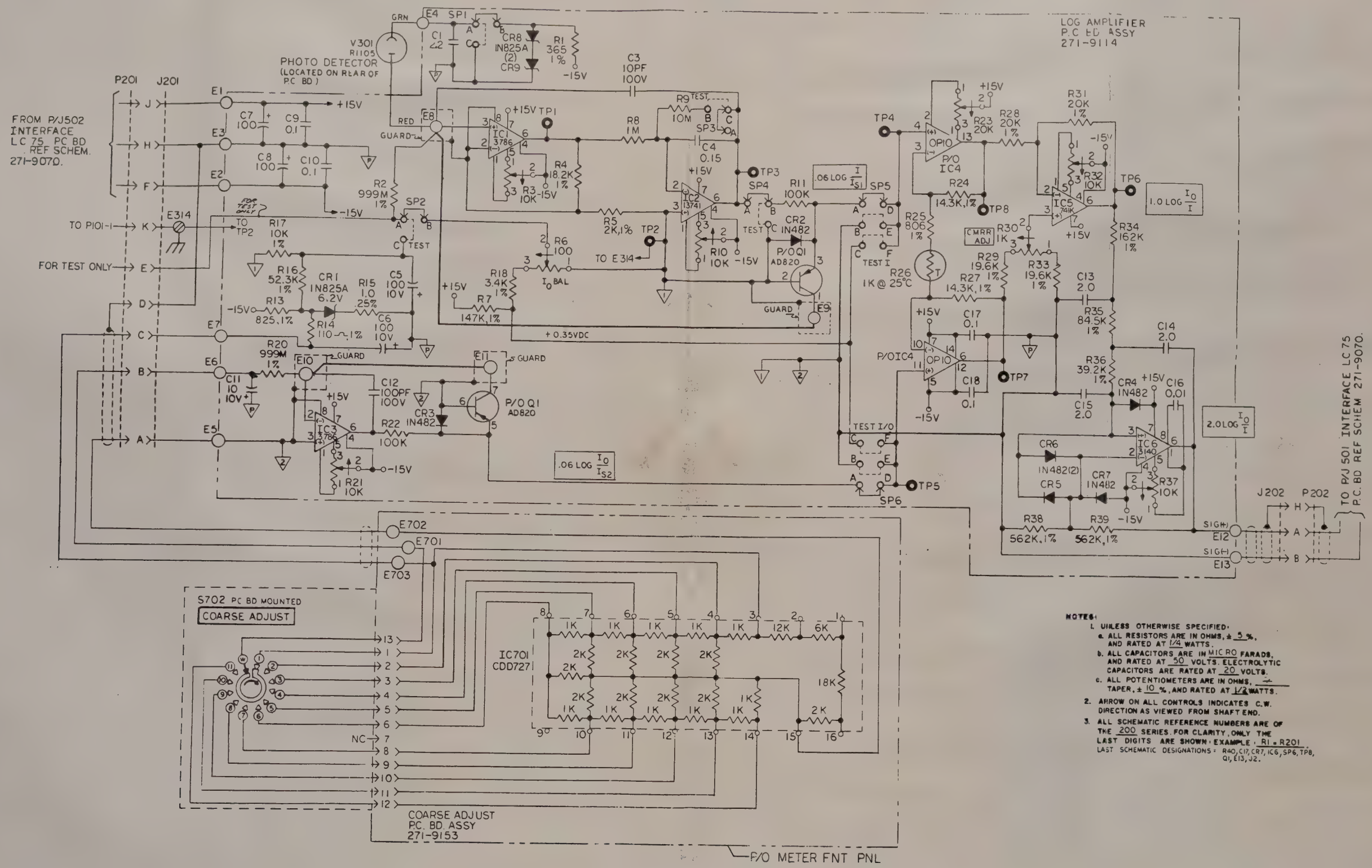
This section is a compilation of schematics required to support circuit descriptions and assist in troubleshooting the Autocontrol.



Interconnection Diagram
0271-0102 (Sheet 1)



Interconnection Diagram
0271-0102 (Sheet 2)

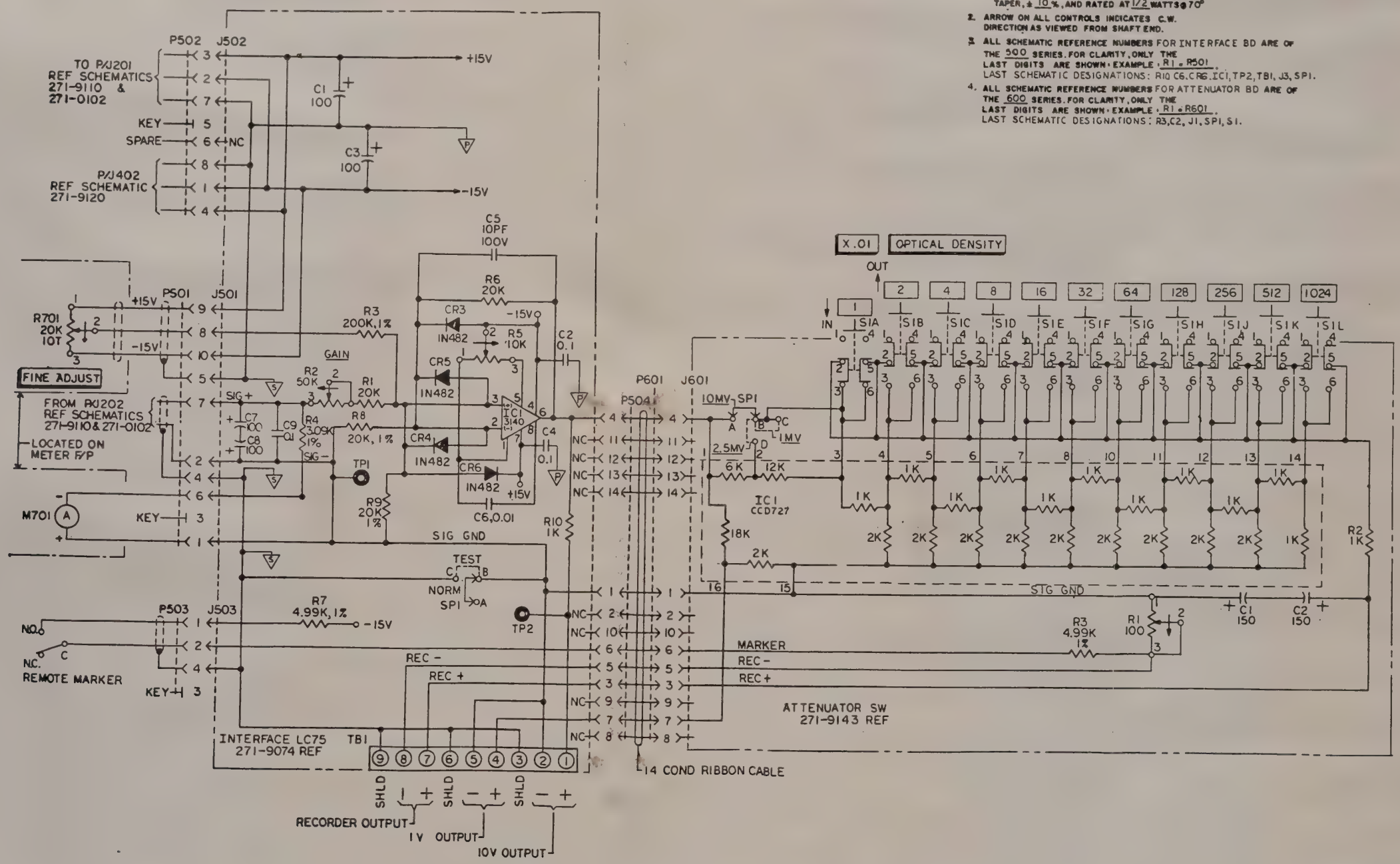


NOTES:

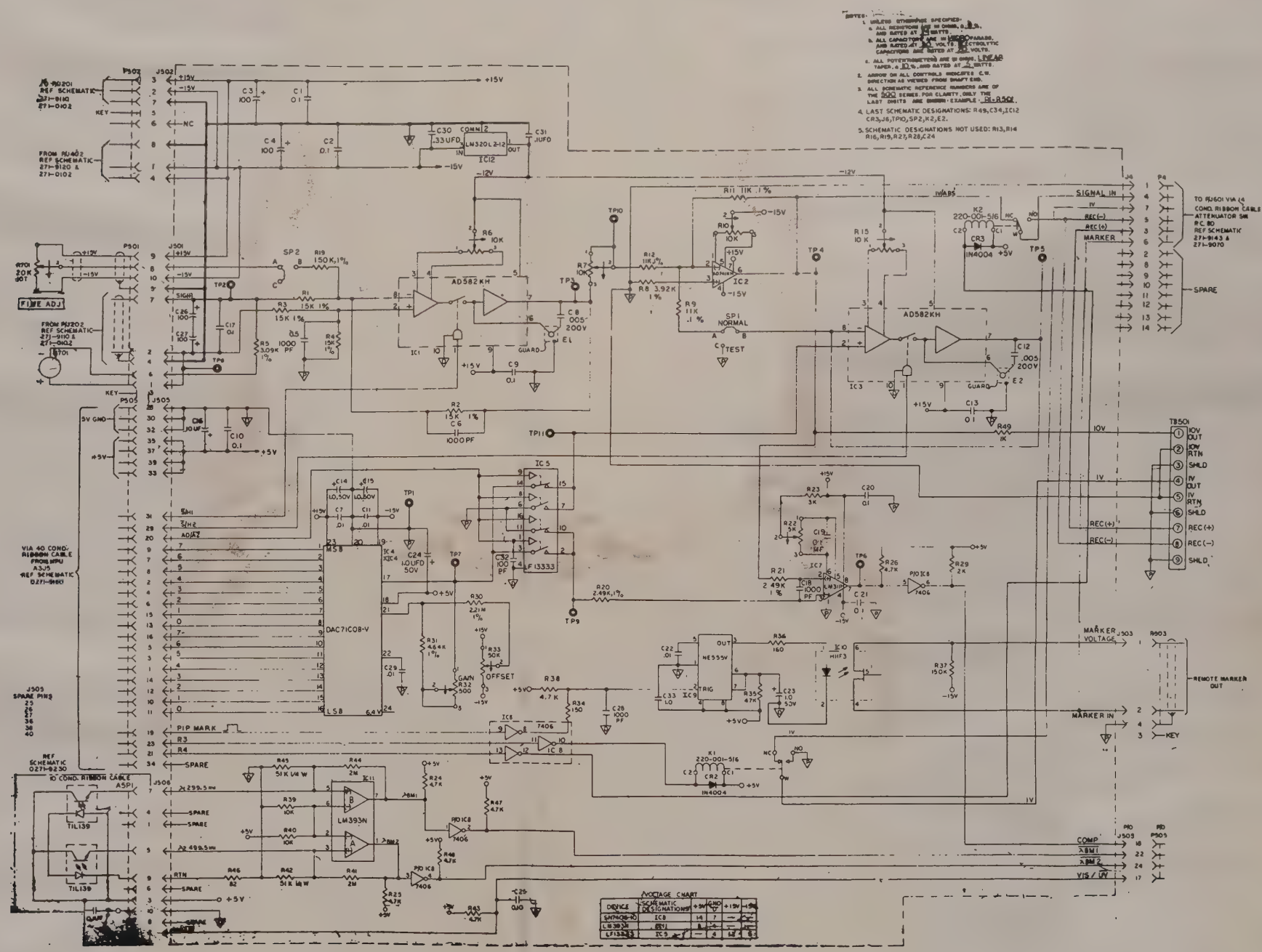
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, — TAPER, ± 10 %, AND RATED AT 1/2 WATTS.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 200 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R201
   LAST SCHEMATIC DESIGNATIONS: R40, C17, CR7, IC6, SP6, TP8, Q1, E13, J2.

Amplifier Schematic
0271-9110

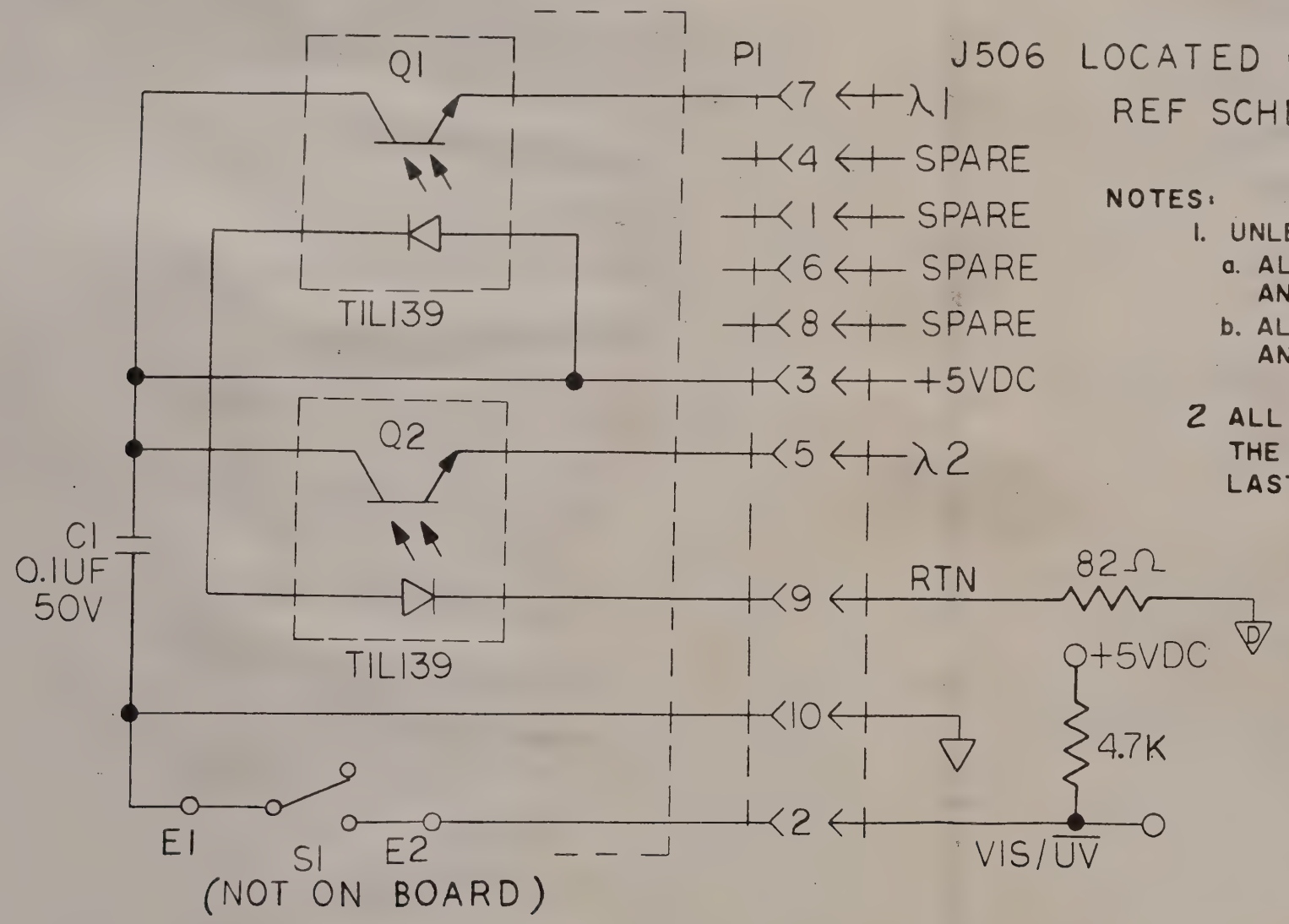
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ——— TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS FOR INTERFACE BD ARE OF THE 500 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R501.
   LAST SCHEMATIC DESIGNATIONS: R10 C6. CR6. IC1, TP2, TB1, J3, SP1.
4. ALL SCHEMATIC REFERENCE NUMBERS FOR ATTENUATOR BD ARE OF THE 600 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R601.
   LAST SCHEMATIC DESIGNATIONS: R3, C2, J1, SP1, S1.



Interface Schematic
0271-9070



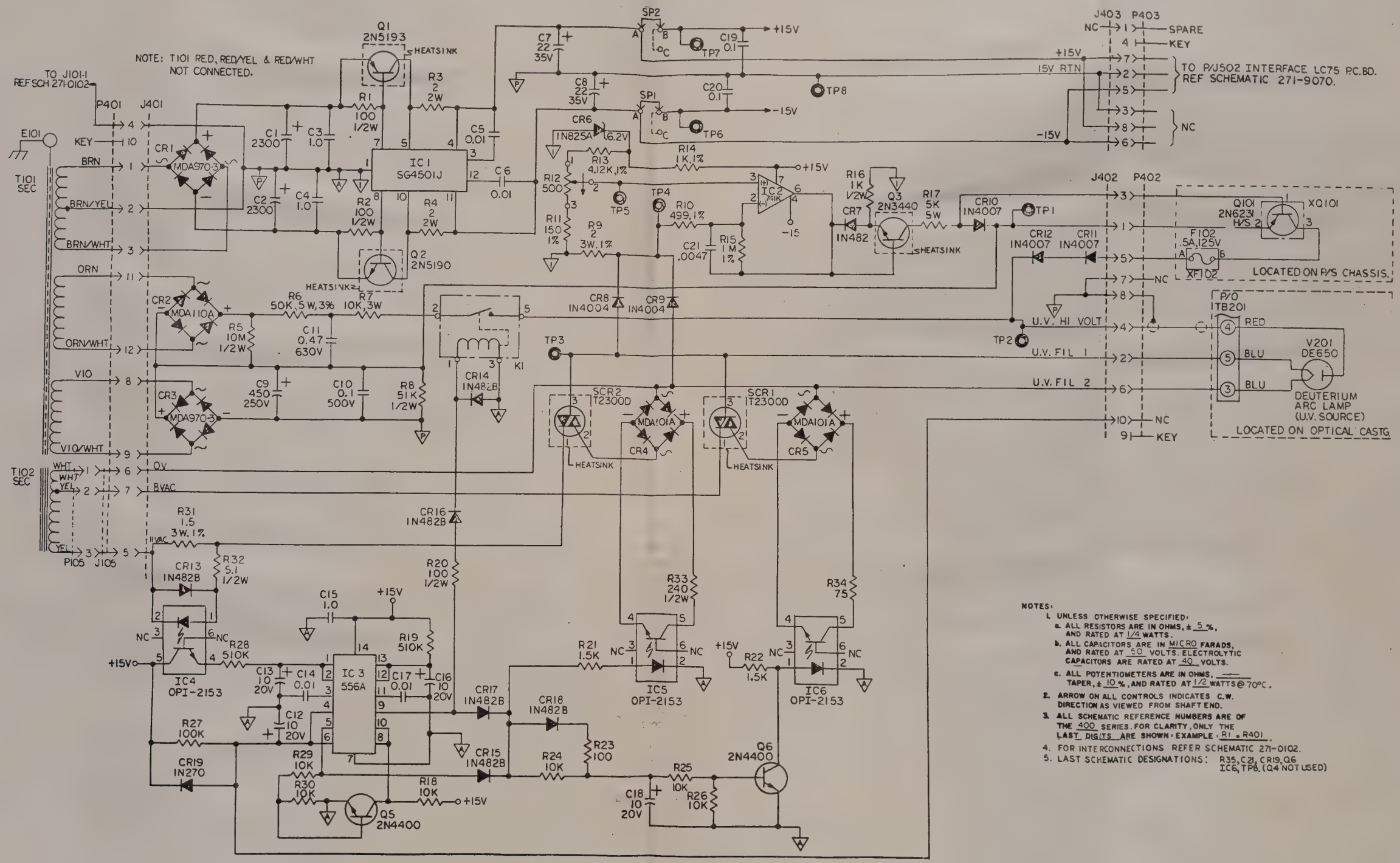
Analog PCB Schematic
0271-9130



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT ___ WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS.

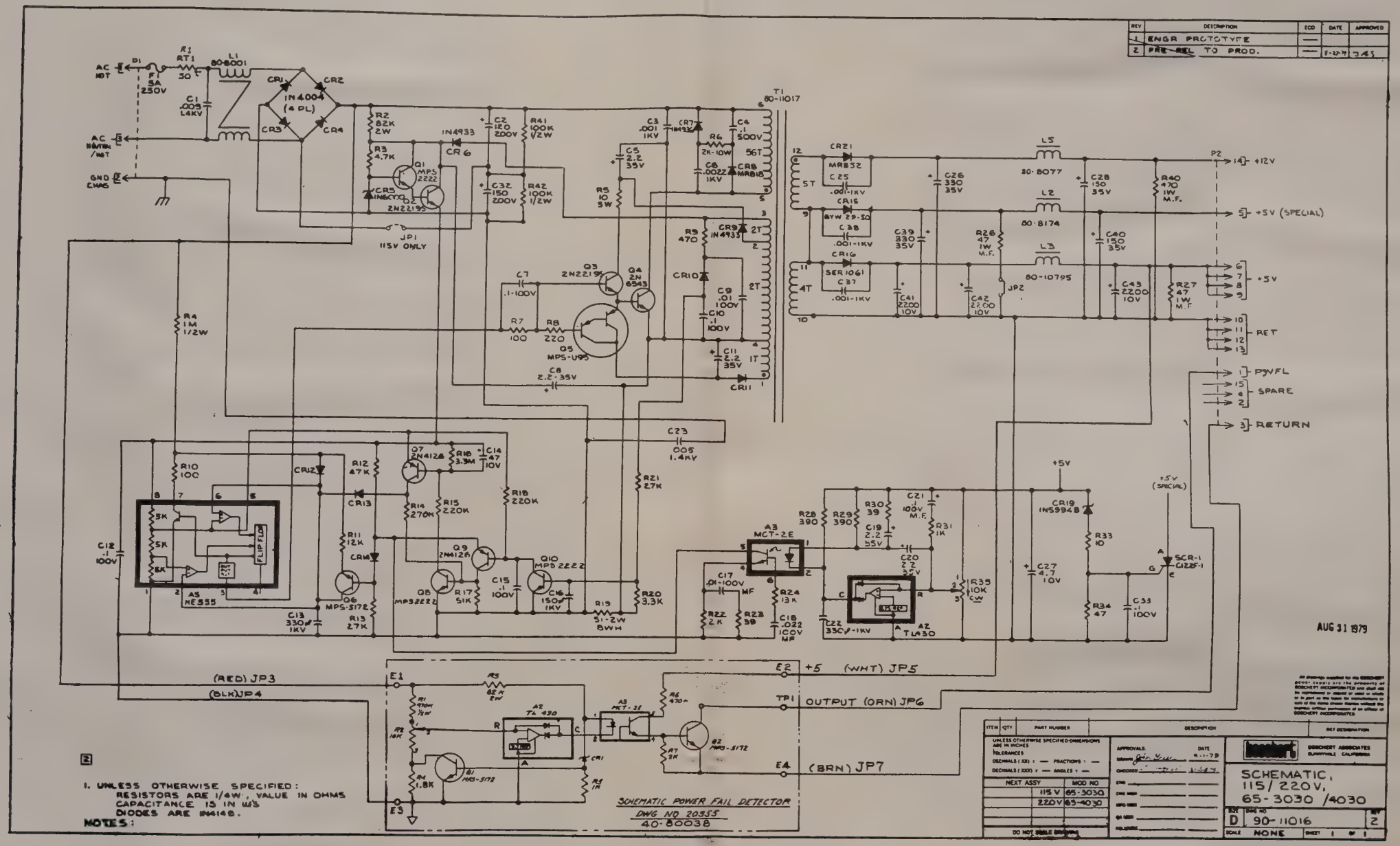
2 ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE A5 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN: EXAMPLE: P = A5P1



NOTES:

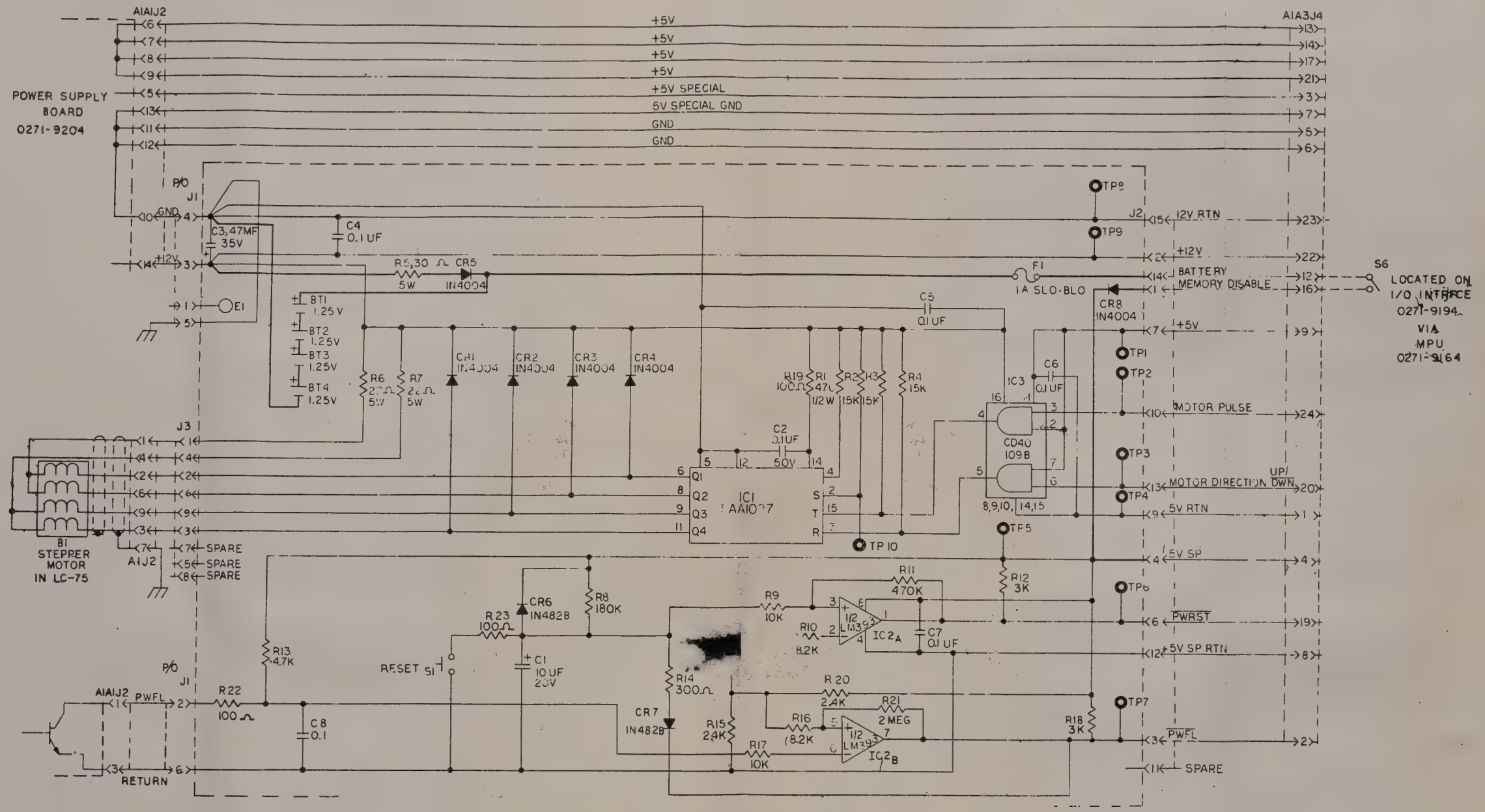
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 40 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ___ TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°C.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 400 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: R1 = R401
4. FOR INTERCONNECTIONS REFER SCHEMATIC 271-0102.
5. LAST SCHEMATIC DESIGNATIONS: R35, C21, CR19, Q6, IC6, TP8. (Q4 NOT USED)

Power Supply/Driver Schematic
0271-9120



This schematic is reproduced here with the kind permission of Boschert Associates of Sunnyvale, California.

Power Supply Schematic
0271-9200

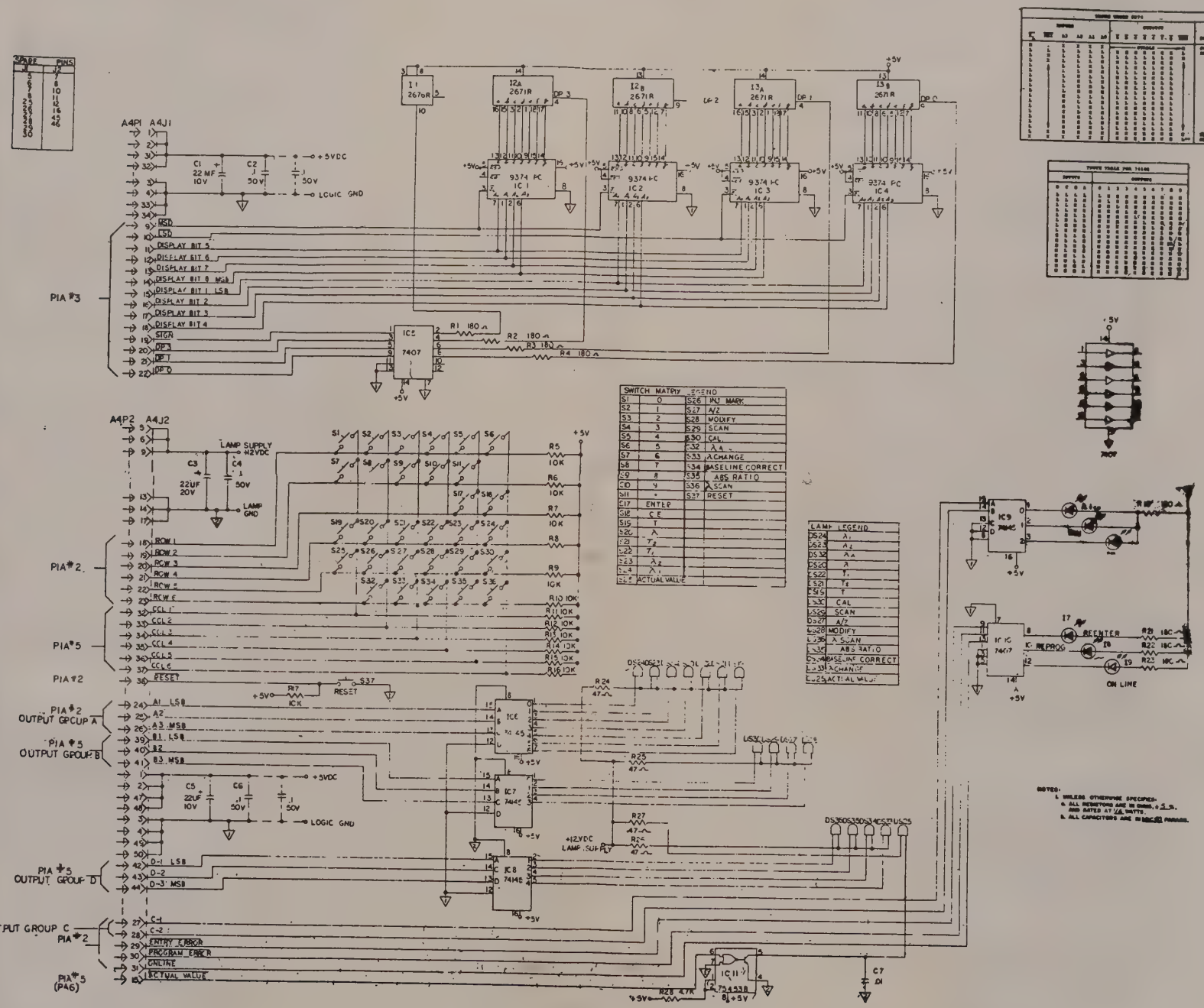


NOTES:

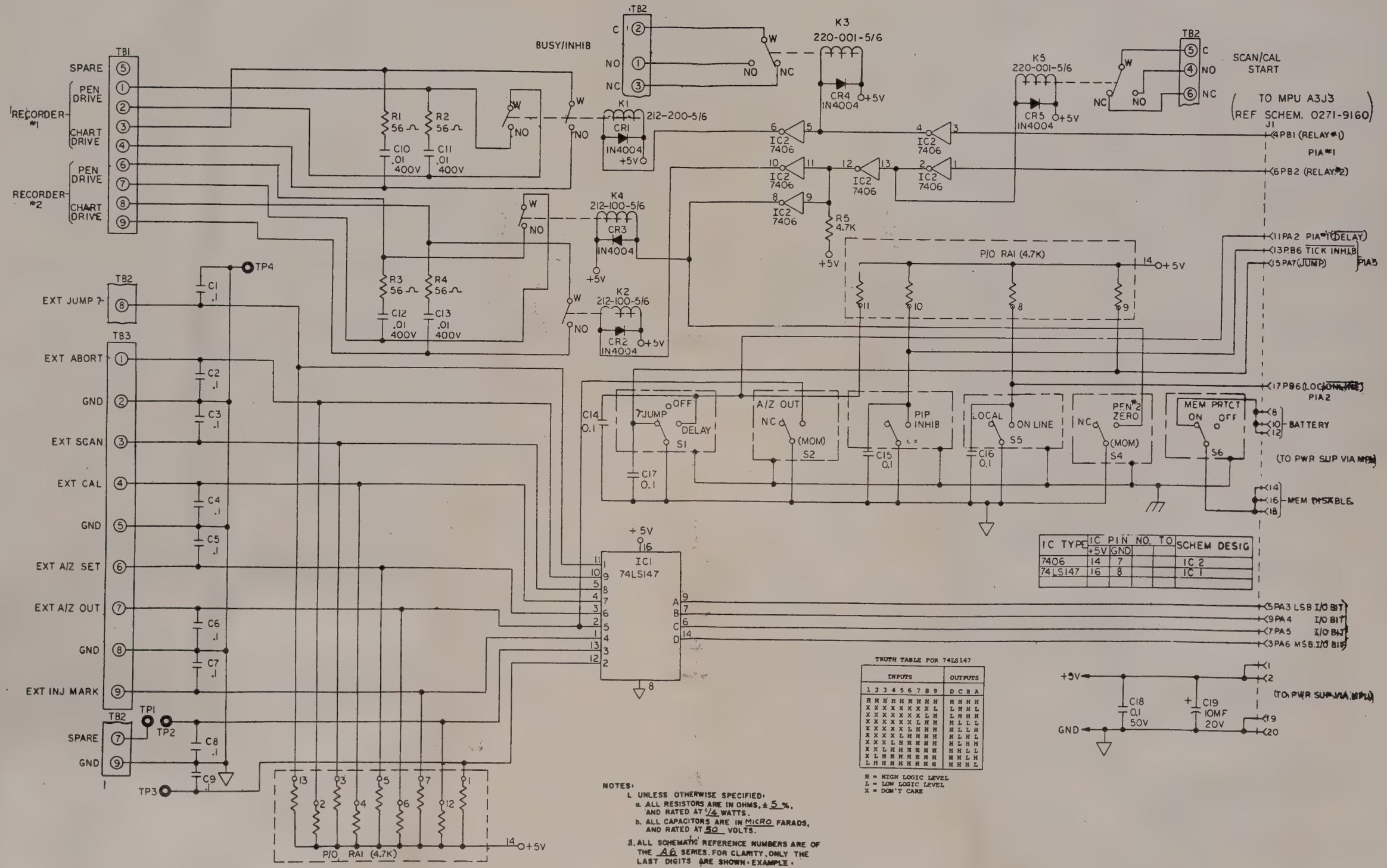
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICROFARADS, AND RATED AT 50 VOLTS.

2. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE A2 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: J1 = A2J1.

Driver Power Supply Interface Schematic
0271-9170



Keyboard/Display Schematic
0271-9180



IC TYPE	IC PIN NO. TO +5V	GND			SCHEM DESIG
7406	14	7			IC 2
74LS147	16	8			IC 1

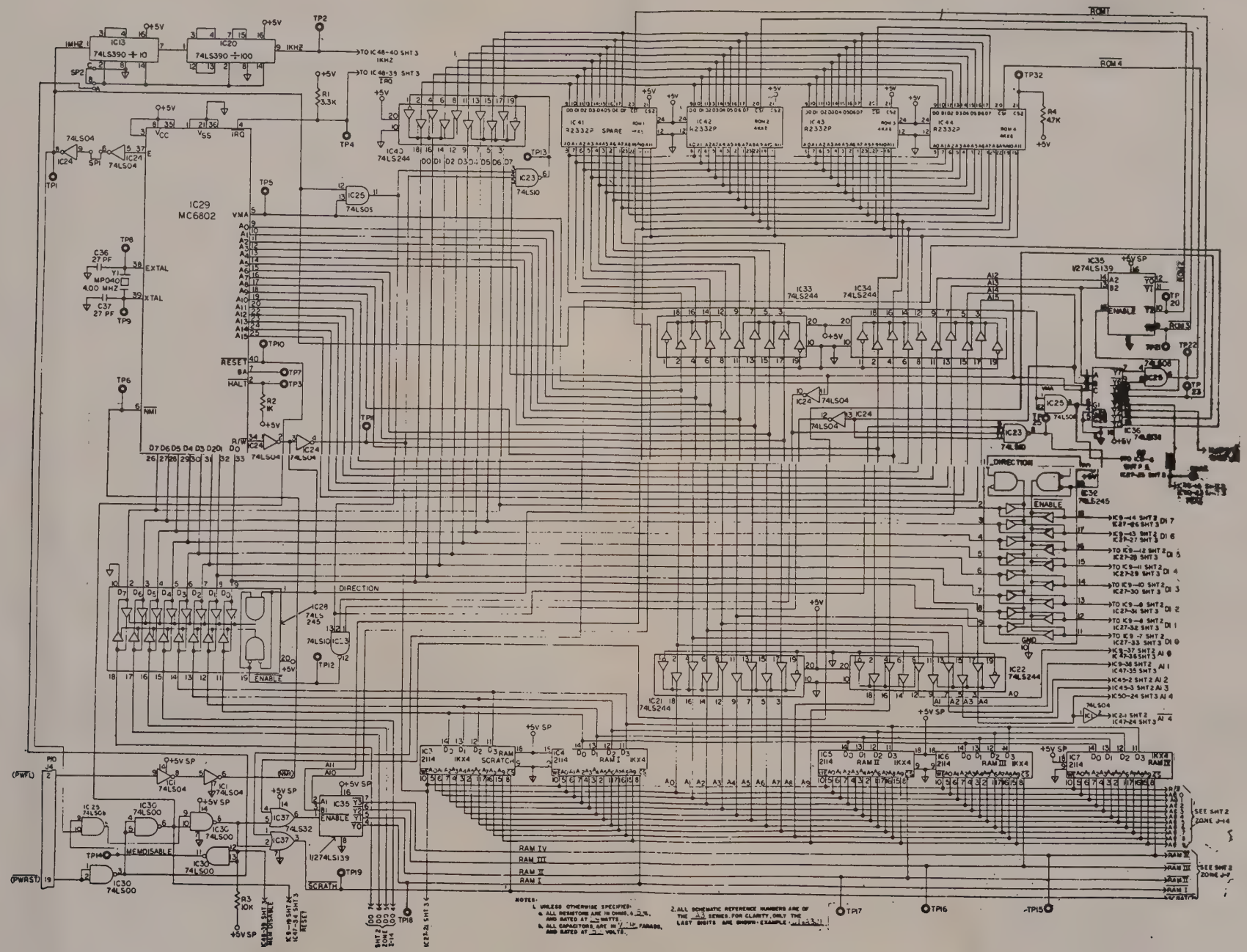
TRUTH TABLE FOR 74LS147

INPUTS 1 2 3 4 5 6 7 8 9	OUTPUTS D C B A
H H H H H H H H H	H H H H
X X X X X X X X L	L H H L
X X X X X X X L H	L H H H
X X X X X X L H H	H L L L
X X X X X L H H H	H L L H
X X X X L H H H H	H L H L
X X X L H H H H H	H L H H
X X L H H H H H H	H H L L
X L H H H H H H H	H H L H
L H H H H H H H H	H H H L

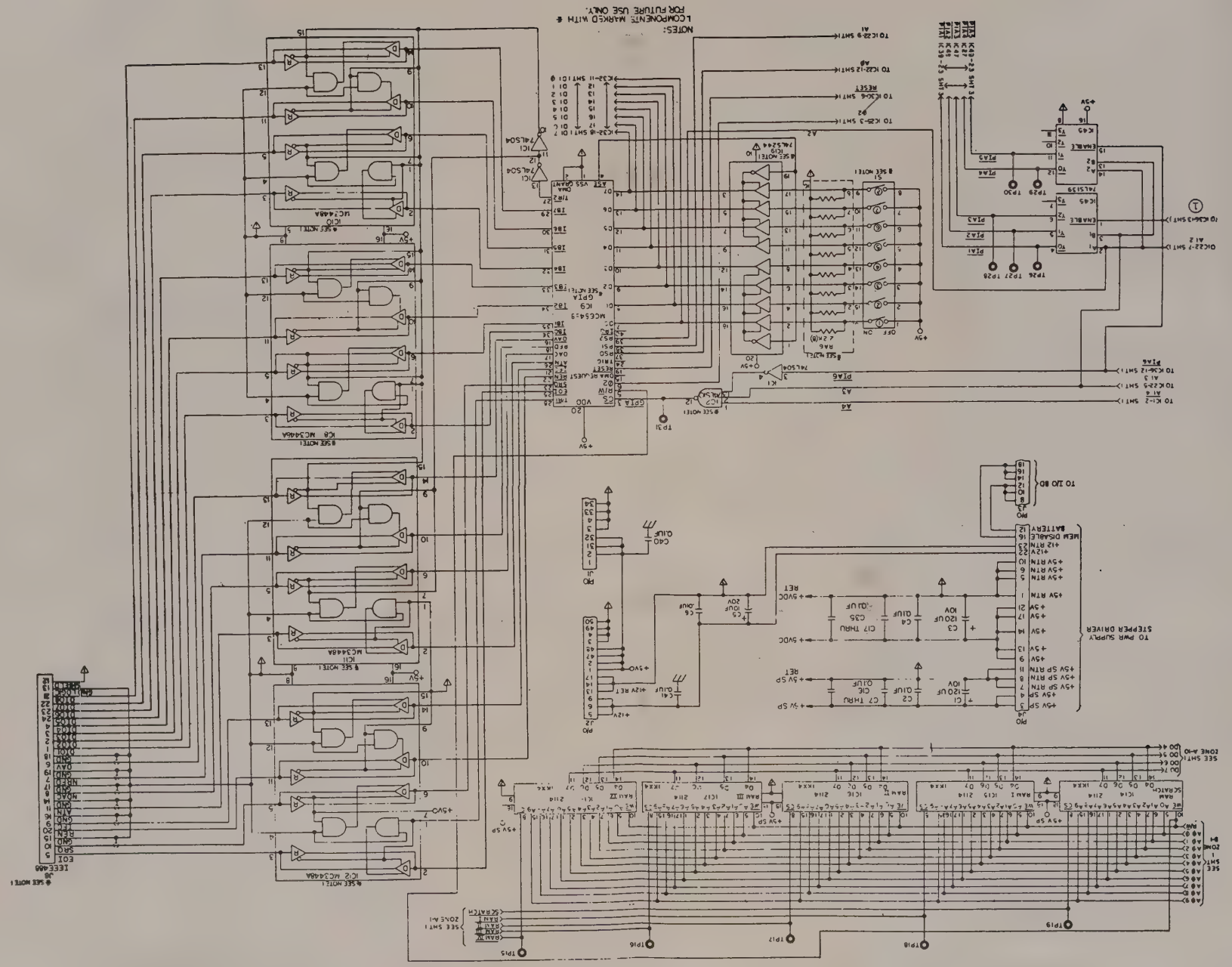
H = HIGH LOGIC LEVEL
L = LOW LOGIC LEVEL
X = DON'T CARE

NOTES:
1. UNLESS OTHERWISE SPECIFIED,
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS.
2. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE A6 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE:

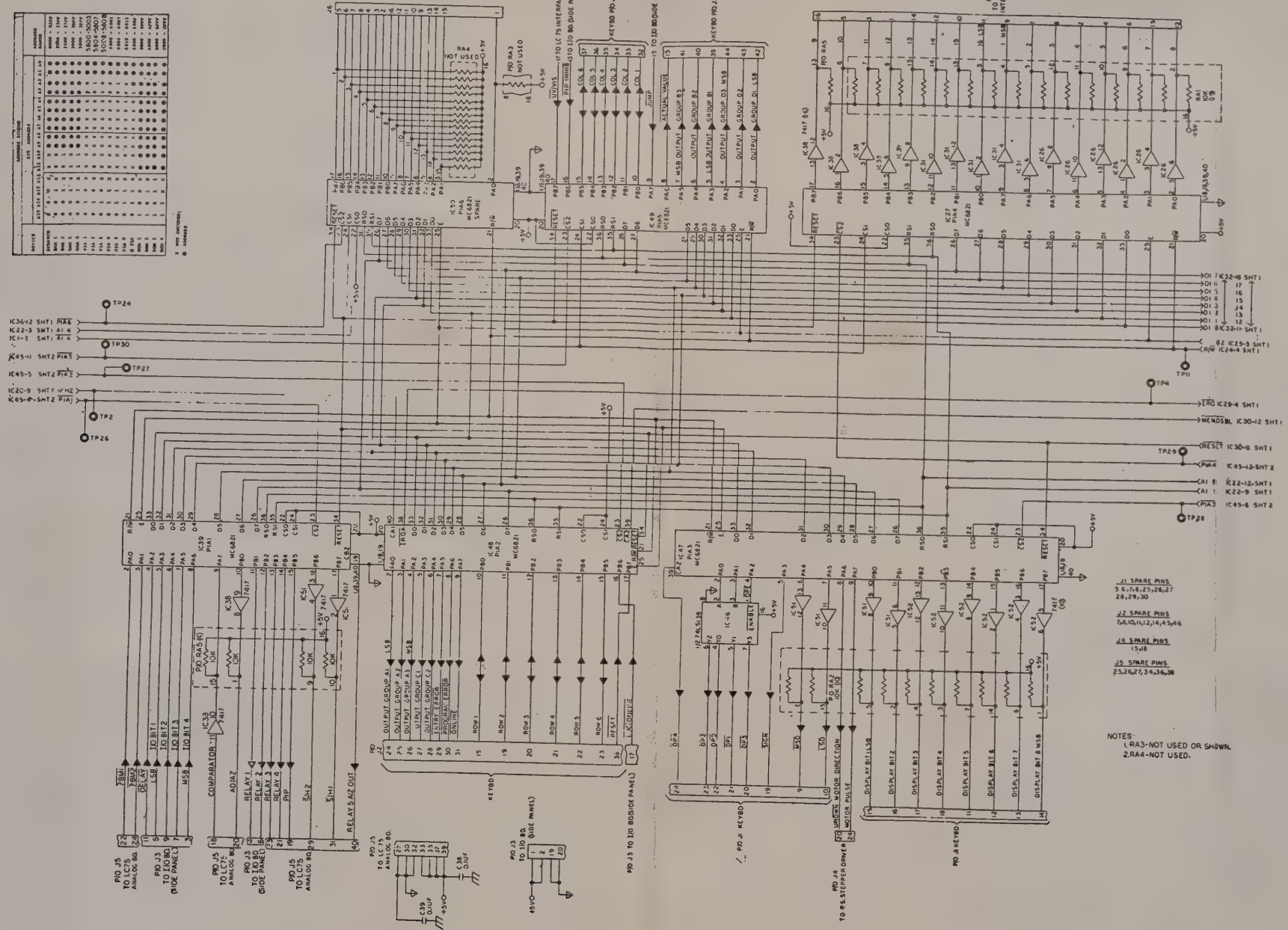
I/O Interface Schematic
0271-9190



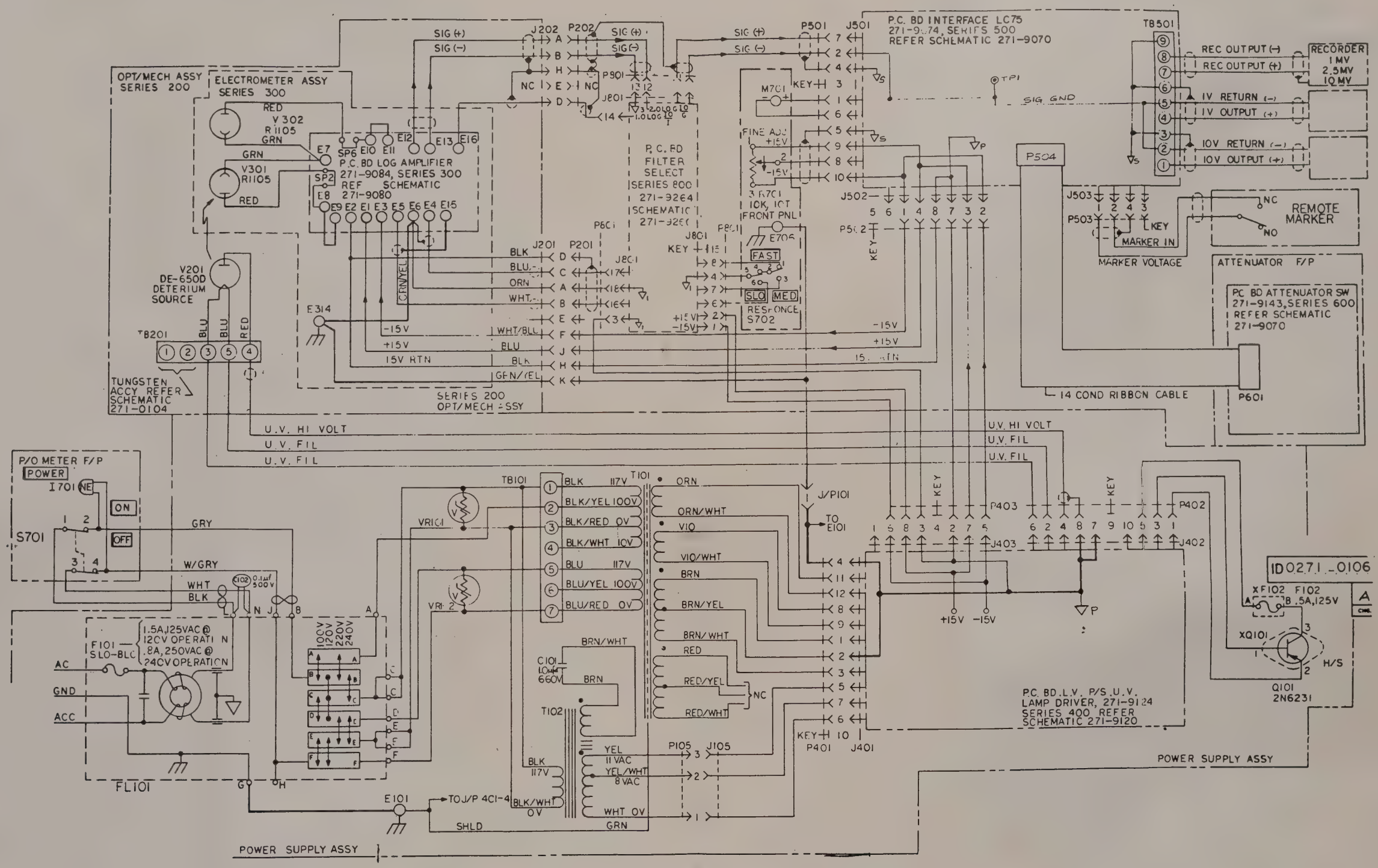
MPU Schematic
0271-9160 (Sheet 1)



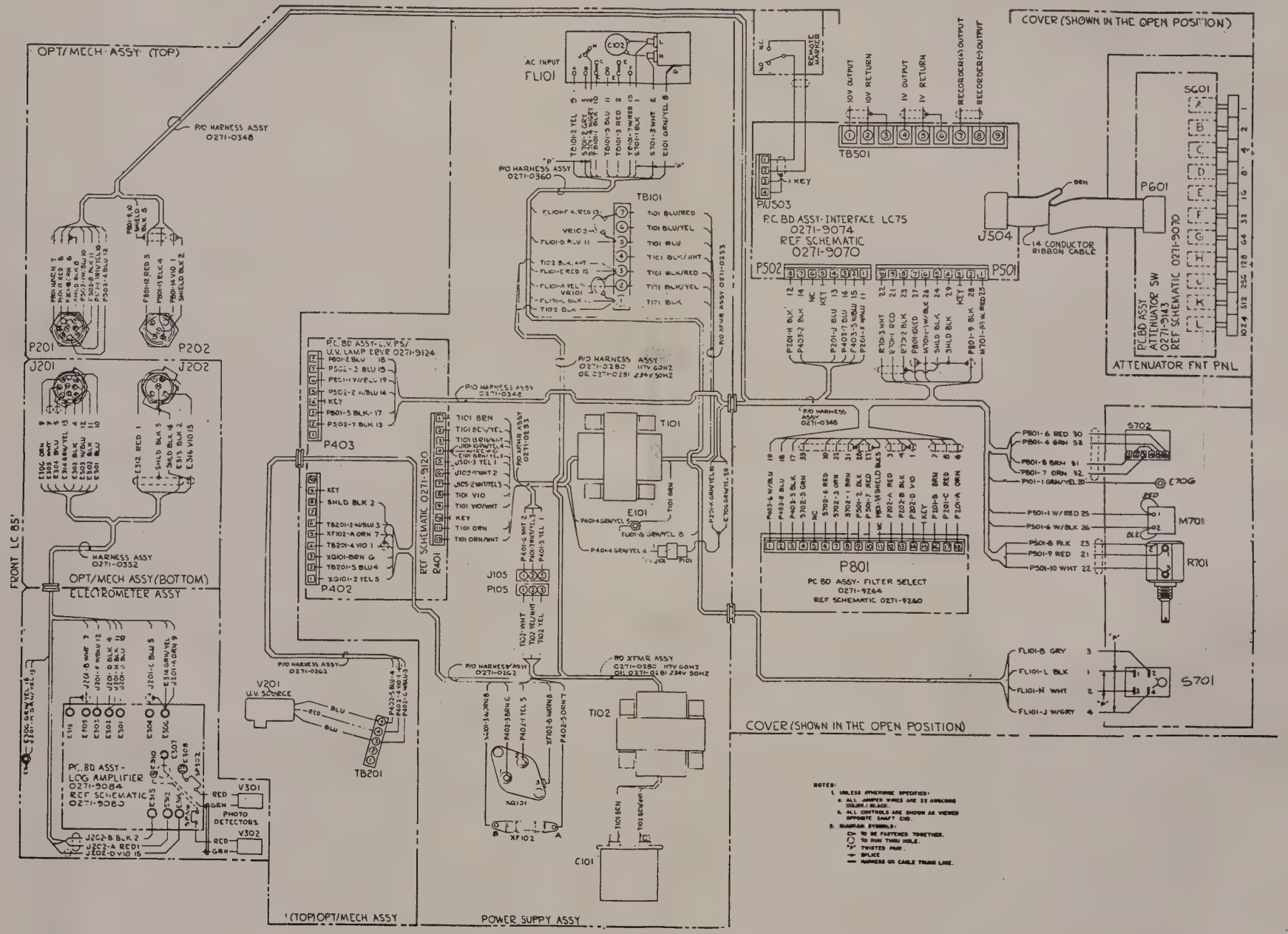
MPU Schematic
0271-9160 (Sheet 2)



MPU Schematic
0271-9160 (Sheet 3)



Interconnect Diagram
0271-0106



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL JUMPER WIRES ARE 22 AWG/MIL COLOR = BLACK.
   b. ALL CONTROLS ARE SHOWN AS VIEWED OPPOSITE SHAFT END.
2. SCHEMATIC SYMBOLS:
   - ⊓⊓ TO BE FASTENED TOGETHER.
   - ○ TO PASS THRU HOLE.
   - "P" TWISTED PAIR.
   - ⊣⊢ SPLICE
   - ═══ HARNESS OR CABLE TRUNK LINE.

Wiring Diagram
0271-0107

LOG AMPLIFIER
P.C. BD. ASSY.
0271-9084

TO INTERFACE PC BD REF SCHM 0271-9070

P201 J201

TO FILTER SELECT PC BD

TO P101

J202 P202

TO F/S PC BD REF SCHEM. 0271-9260

JUMPER WIRE

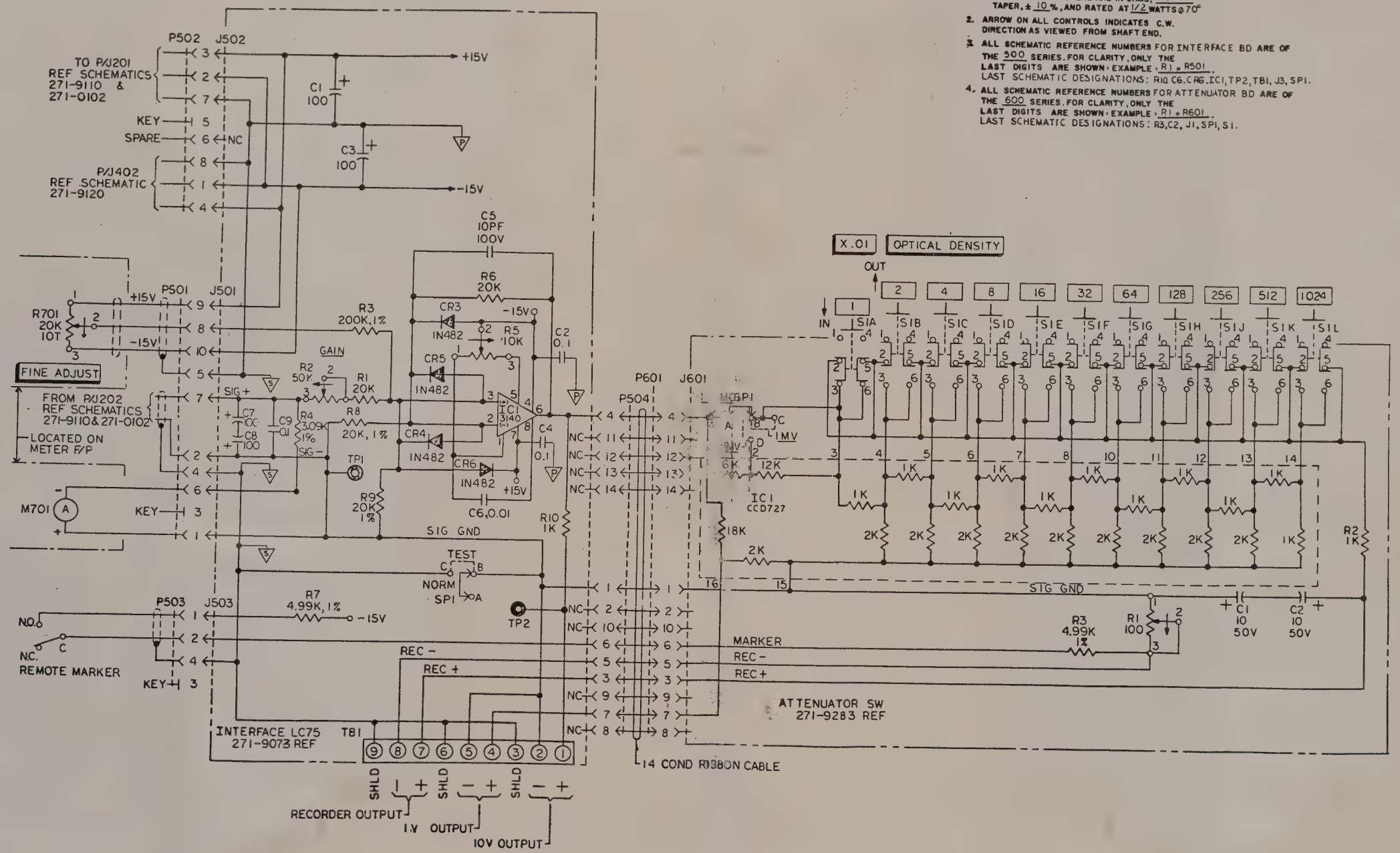
JUMPER WIRE

NOTES:

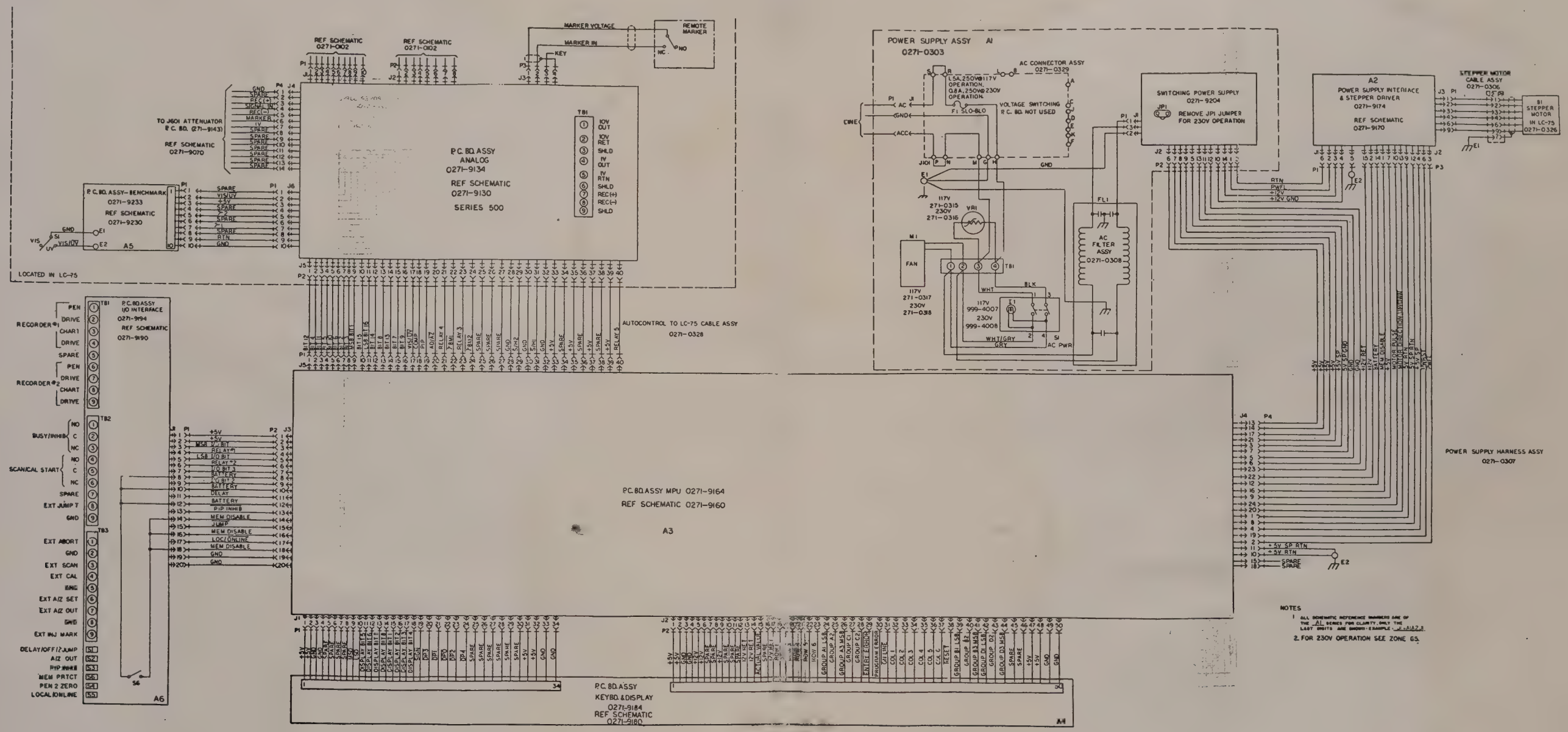
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS. MULTIPLE SECTION ELECTROLYTICS ARE CODED AS FOLLOWS: A__B__C__D-UNCODED.
   c. ALL POTENTIOMETERS ARE IN OHMS, _____ TAPER, ± ___ %, AND RATED AT ___ WATTS.
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE 300 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN. EXAMPLE: ___

Amplifier Schematic
0271-9080

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a. ALL RESISTORS ARE IN OHMS, ± 5 %, AND RATED AT 1/4 WATTS.
   b. ALL CAPACITORS ARE IN MICRO FARADS, AND RATED AT 50 VOLTS. ELECTROLYTIC CAPACITORS ARE RATED AT 20 VOLTS.
   c. ALL POTENTIOMETERS ARE IN OHMS, ——— TAPER, ± 10 %, AND RATED AT 1/2 WATTS @ 70°
2. ARROW ON ALL CONTROLS INDICATES C.W. DIRECTION AS VIEWED FROM SHAFT END.
3. ALL SCHEMATIC REFERENCE NUMBERS FOR INTERFACE BD ARE OF THE 500 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN: EXAMPLE: R1 = R501. LAST SCHEMATIC DESIGNATIONS: R1Q C6, CR6, IC1, TP2, TB1, J3, SP1.
4. ALL SCHEMATIC REFERENCE NUMBERS FOR ATTENUATOR BD ARE OF THE 600 SERIES. FOR CLARITY, ONLY THE LAST DIGITS ARE SHOWN: EXAMPLE: R1 = R601. LAST SCHEMATIC DESIGNATIONS: R3, C2, J1, SP1, S1.



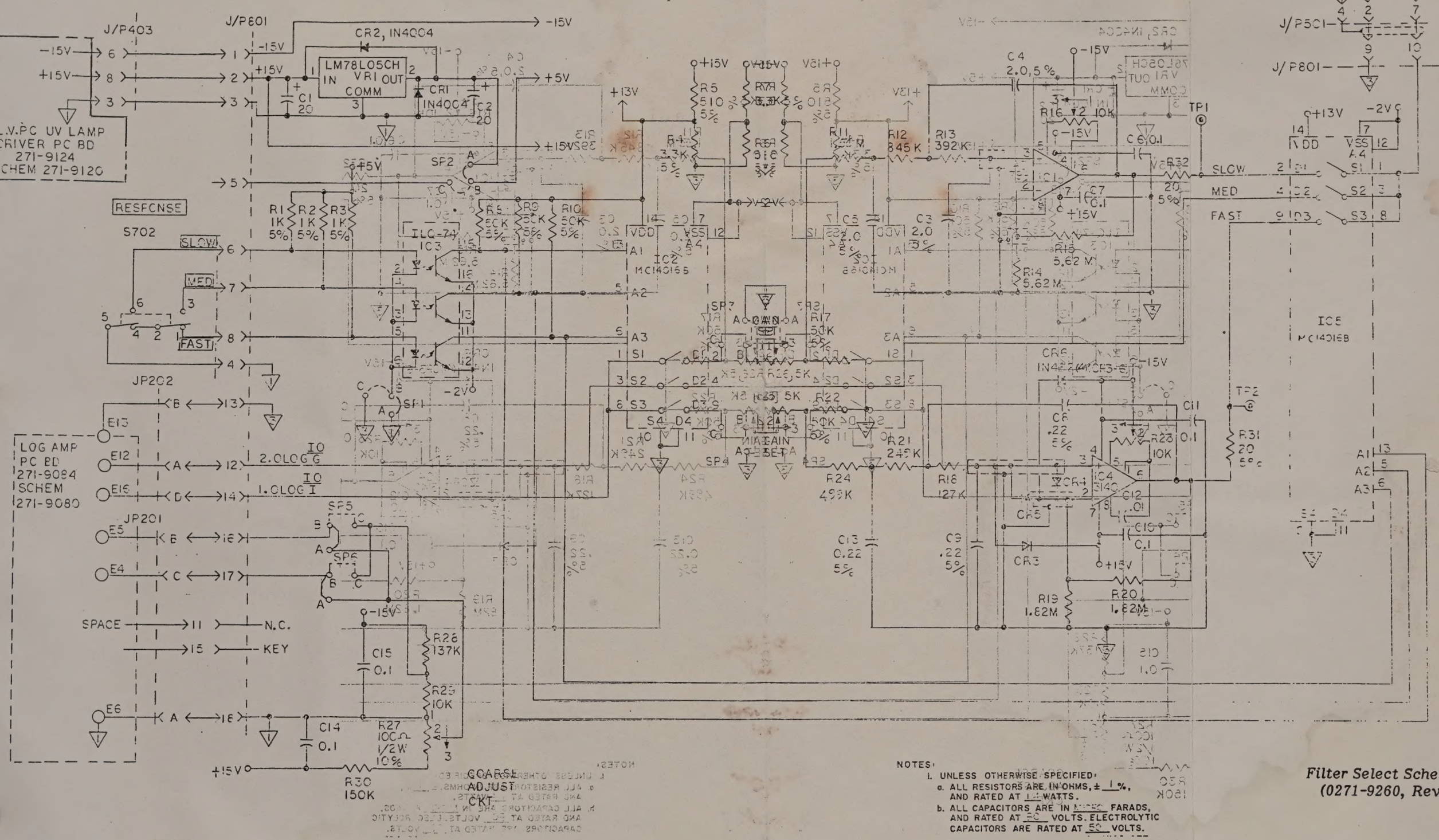
Interface Schematic
0271-9280



NOTES

1. ALL SCHEMATIC REFERENCE NUMBERS ARE OF THE A1 SERIES FOR CLARITY. ONLY THE LAST DIGITS ARE SHOWN - EXAMPLE - J1 = A1J1
2. FOR 230V OPERATION SEE ZONE 6S

Interconnection Diagram
0271-0323



Filter Select Schematic (0271-9260, Rev. E)

MP MASTER
MA32947